DOUBLE BLOCK PRE-ALGEBRA / ALGEBRA 1 HONORS

1205070 / 1200320

Instructional Resource: McGraw-Hill: *Florida Math, Course 3, Volume 1 & 2*, ©2015
Instructional Resource: McGraw-Hill: *Florida Algebra 1*, ©2015

Course Pacing

Unit of Instruction	# of Days	Dates of Instruction
P-A Unit 1: Real Numbers	9	8/16 – 8/28
P-A Unit 2: Linear Equations in One Variable	8	8/29 – 9/10
P-A Unit 3: Linear Equations in Two Variables	10	9/11 – 9/24
P-A Unit 4: Functions	6	9/25 – 10/3
Cycle 1 Assessment (Review and Units 1-4)	**1**	**10/3** (9/30 – 10/11)
P-A Unit 5: Triangles and Pythagorean Theorem	8	10/4 – 10/16
P-A Unit 6: Transformations, Congruence & Similarity	12	10/17 – 11/1
P-A Unit 7: Volume	8	11/4 – 11/13
P-A Unit 8: Scatter Plots and Data Analysis	7	11/14 – 11/22
Thanksgiving Break 11/23 – 12/1 --- Switch to Algebra 1 Honors Instruction after the Break		
A1H Unit 1: Summarize, represent, and interpret data on a single count or measurement variable.	4	12/2 – 12/5
A1H Unit 2: Interpret linear models.	4	12/6 – 12/11
Midterm Exam (& Review) Pre-Algebra Content Only (Units 5-8)	**1**	**12/12 – 12/20**
A1H Unit 3: Use properties of rational and irrational numbers.	2	1/8 – 1/9
A1H Unit 4: Extend the properties of exponents to rational exponents.	3	1/10 – 1/14
A1H Unit 5: Understand the concept of a function and use function notation. Interpret functions that arise in applications in terms of the context.	5	1/15 – 1/22
A1H Unit 6: Interpret the structure of expressions	2	1/23 -1/24
A1H Unit 7: Create and solve equations and inequalities	6	1/27 – 2/3
A1H Unit 8: Represent and solve equations and inequalities graphically.	6	2/4 – 2/11
A1H Unit 9: Solve systems of equations and inequalities	4	2/12 – 2/18
A1H Unit 10: Perform arithmetic operations on polynomials.	6	2/19 – 2/26
A1H Unit 11: Polynomial relationships and identities.	7	2/27 – 3/6
A1H Unit 12: Solve quadratic expressions Spring Break 3/14 – 3/23	6	3/9 – 3/24
A1H Unit 13: Construct and compare linear, quadratic, and exponential models and solve problems.	8	3/25 – 4/3
A1H Unit 14: Interpreting and analyzing functions.	4	4/6 – 4/9
A1H Unit 15: Build a function that models a relationship between two quantities.	5	4/13 – 4/17
A1H Unit 16: Building new functions from existing functions.	3	4/20 – 4/22
A1H Unit 17: Summarize, represent, and interpret data on two categorical and quantitative variables.	3	4/23 – 4/27
Algebra 1 EOC	**2**	**5/4 – 5/29**

Pinellas County Schools

DOUBLE BLOCK PRE-ALGEBRA/ALGEBRA 1 HONORS

2019-2020

August 2019

				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

September 2019

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

October 2019

		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November 2019

					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

December 2019

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Building Community in the Math Classroom

Unit 1: Real Numbers
MAFS.8.NS.1.1 MAFS.8.EE.1.2
MAFS.8.NS.1.2 MAFS.8.EE.1.3
MAFS.8.EE.1.1 MAFS.8.EE.1.4

Unit 2: Linear Equations in One Variable
MAFS.8.EE.3.7

Unit 3: Linear Equations in Two Variables
MAFS.8.EE.2.5 MAFS.8.EE.3.8
MAFS.8.EE.2.6

Unit 4: Functions
MAFS.8.F.1.1 MAFS.8.F.2.4
MAFS.8.F.1.2 MAFS.8.F.2.5
MAFS.8.F.1.3

Cycle 1 Assessment
All standards from Pre-Algebra Units 1-4

Unit 5: Triangles and Pythagorean Theorem
MAFS.8.G.1.5 MAFS.8.G.2.7
MAFS.8.G.2.6 MAFS.8.G.2.8

Unit 6: Transformations, Congruence & Similarity
MAFS.8.G.1.1 MAFS.8.G.1.4
MAFS.8.G.1.2 MAFS.8.G.1.5
MAFS.8.G.1.3 MAFS.8.EE.2.6

Unit 7: Volume
MAFS.8.G.3.9

Unit 8: Scatter Plots and Data Analysis
MAFS.8.SP.1.1 MAFS.8.SP.1.3
MAFS.8.SP.1.2 MAFS.8.SP.1.4

SWITCH TO ALGEBRA 1 HONORS INSTRUCTION!!!

Unit 1: Summarize, represent, and interpret data on a single count or measurement variable.
MAFS.912.S-ID.1.1 MAFS.912.S-ID.1.3
MAFS.912.S-ID.1.2 *MAFS.912.S-ID.1.4

Unit 2: Interpret linear models.
MAFS.912.S-ID.3.7 MAFS.912.S-ID.3.9
MAFS.912.S-ID.3.8

Semester 1 Review and Exam
All standards from Pre-Algebra Units 5-8

Unit 3: Use properties of rational and irrational numbers. (Semester 2)
MAFS.912.N-RN.2.3

Unit 4: Extend the properties of exponents to rational exponents. (Semester 2)
MAFS.912.N-RN.1.1 MAFS.912.N-RN.1.2

UNIVERSAL STANDARDS
MAFS.912.N-Q-1.1 MAFS.912.N-Q.1.3
MAFS.912.N-Q.1.2

Re-Building Community in the Math Classroom

Unit 5: Understand the concept of a function and use function notation. Interpret functions that arise in applications in terms of the context.
MAFS.912.F-IF.1.1 MAFS.912.F-IF.1.3
MAFS.912.F-IF.1.2 MAFS.912.F-IF.2.4

Unit 6: Interpret the structure of expressions.
MAFS.912.A-SSE.1.1

Unit 7: Create and solve equations and inequalities.
MAFS.912.A-CED.1.1 MAFS.912.A-REI.1.1
MAFS.912.A-CED.1.2 *MAFS.912.A-REI.1.2
MAFS.912.A-CED.1.4 MAFS.912.A-REI.2.3

Unit 8: Represent and solve equations and inequalities graphically.
MAFS.912.A-CED.1.3 MAFS.912.A-REI.4.11
MAFS.912.A-REI.4.10 MAFS.912.A-REI.4.12

Unit 9: Solve systems of equations.
MAFS.912.A-REI.3.5 MAFS.912.A-REI.3.6
MAFS.912.A-REI.4.12

Unit 10: Perform arithmetic operations on polynomials.
MAFS.912.A-APR.1.1

Unit 11: Polynomial relationships and identities.
*MAFS.912.A-APR.2.2 *MAFS.912.A-APR.4.6
MAFS.912.A-APR.2.3 MAFS.912.A-SSE.1.2
*MAFS.912.A-APR.3.4

Unit 12: Solve quadratic equations.
MAFS.912.A-REI.2.4 MAFS.912.A-SSE.2.3
*MAFS.912.A-REI.3.7

Unit 13: Construct and compare linear, quadratic, and exponential models and solve problems.
MAFS.912.F-LE.1.1 MAFS.912.F-LE.1.3
MAFS.912.F-LE.1.2 MAFS.912.F-LE.2.5

Unit 14: Interpreting and analyzing functions.
MAFS.912.F-IF.2.5 MAFS.912.F-IF.3.8
MAFS.912.F-IF.2.6 MAFS.912.F-IF.3.9
MAFS.912.F-IF.3.7

Unit 15: Build a function that models a relationship between two quantities.
MAFS.912.F-BF.1.1 *MAFS.912.A-SSE.2.4
*MAFS.912.F-BF.1.2

Unit 16: Building new functions from existing functions.
MAFS.912.F-BF.2.3 *MAFS.912.F-BF.2.4

Unit 17: Summarize, represent, and interpret data on two categorical and quantitative variables.
MAFS.912.S-ID.2.6 MAFS.912.S-ID.2.6

FSA Algebra 1 EOC
May 1-28, 2018

January 2020

			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February 2020

						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

March 2020

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

April 2020

			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

May 2020

					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

June 2020

1	2	3	4	5	6

Pre-Algebra	**Unit 1: Real Numbers**	9 days: 8/16-8/28
Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**	
MAFS.8.NS.1.1 Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.	• All irrational numbers excluding *e*. • Only rational numbers with repeating decimal expansions up to thousandths may be used. Calculator: **NO** • Editing Task Choice • Equation Editor • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response	
MAFS.8.NS.1.2 Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2). *For example, by truncating the decimal expansion of* $\sqrt{2}$ *is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.*	• All real numbers excluding *e*. • Irrational expressions should only use one operation. Calculator: **NO** • Equation Editor • GRID • Multiple Choice • Multiselect • Open Response	
MAFS.8.EE.1.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example,* $3^2 \times 3^{-5} = 3^{-3} = 1/3^2 = 1/27$.	• Exponents must be integers. • Bases must be whole numbers • Variables may not be used. Calculator: **NO** • Equation Editor • GRID • Matching Item • Multiple Choice • Multiselect	
MAFS.8.EE.1.2 Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where *p* is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.	• Square roots and cube roots may be used to represent solutions to equations. • Radicands may be rational or irrational. • Radicands may not include variables. Calculator: **NEUTRAL** • Equation Editor • Matching Item • Multiple Choice • Multiselect	
MAFS.8.EE.1.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as 3 times* 10^8 *and the population of the world as 7 times* 10^9*, and determine that the world population is more than 20 times larger.*	• N/A Calculator: **NO** • Editing Task Choice • Equation Editor • Hot Text • Multiple Choice • Open Response	
MAFS.8.EE.1.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.	• N/A Calculator: **NO** • Editing Task Choice • Equation Editor • Hot Text • Matching Item • Multiple Choice • Open Response	

Open Up Resources Lessons
Grade 8, Unit 7: Exponents and Scientific Notation • Lesson 1: Exponent Review

- Lesson 2: Multiplying Powers of Ten
- Lesson 3: Powers of Powers of 10
- Lesson 4: Dividing Powers of 10
- Lesson 5: Negative Exponents with Powers of 10
- Lesson 6: What about Other Bases?
- Lesson 7: Practice with Rational Bases
- Lesson 8: Combining Bases
- Lesson 9: Describing Large and Small Numbers Using Powers of 10
- Lesson 10: Representing Large Numbers on the Number Line
- Lesson 11: Representing Small Numbers on the Number Line
- Lesson 12: Applications of Arithmetic with Powers of 10
- Lesson 13: Definition of Scientific Notation
- Lesson 14: Multiplying, Dividing, and Estimating with Scientific Notation
- Lesson 15: Adding and Subtracting with Scientific Notation

Grade 8, Unit 8: Pythagorean Theorem and Irrational Numbers

- Lesson 14: Decimal Representations of Rational Numbers
  Lesson 15: Infinite Decimal Expansions

Decoded Standard

MAFS.8.NS.1.1

Students expand their knowledge of the Real Number System to include irrational numbers. A diagram shows the relationship of the subsets:

see image on page 71 of the Common Core Mathematics Companion

An irrational number is a decimal whose expansion does not terminate or repeat. Irrational numbers cannot be written in fraction form. Using decimal expressions, students compare rational numbers and irrational numbers to show that rational number expansion repeat and irrational numbers expansions do not. The notation "…" means "continues indefinitely without repeating." For example, $0.\overline{3}$ is a ration number that repeats but $\pi = 3.1415 \ldots$ does not repeat.

To convert a decimal expansion into a fraction:

Change $0.\overline{5}$ to a fraction

1. Let $x = 0.555 \ldots$
2. Multiply both sides so that the repeating digits will be in front of the decimal. In this case, one digit repeats so both sides are multiplied by 10, giving $10x = 5.555 \ldots$
3. Subtract the original equation from the new equation.

$$10x = 5.555 \ldots$$
$$\underline{-x = 0.555 \ldots}$$
$$9x = 5$$

4. Solve the equation by dividing both sides of the equation by 9.
5. $x = \frac{5}{9}$

(*Common Core Mathematics Companion*, Pg. 71)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Rational Numbers Identify rational numbers from a list of real numbers.
- Fraction to Decimal Conversion Given a fraction to convert to a decimal; determine if the decimal repeats.
- Decimal to Fraction Conversion Given several terminating and repeating decimals to convert to fractions.

Illustrative Mathematics

Lesson Resources

Engage NY

- Grade 8, Module 7, Topic B, Lesson 8 Decimal expansion

McGraw-Hill

Course 3, Chapter 1

Lesson 1

• Converting Decimal Representations of Rational Numbers to Fraction Representations Convert repeating decimals into fractions • Repeating or Terminating? Understand why terminating decimal numbers can also be written as repeating decimals where the repeating part is all 9's.	

Decoded Standard

MAFS.8.NS.1.2

Students compare irrational numbers and locate them on a number line by finding their rational approximations. Find rational approximations by creating lists of numbers by answering the following question: Between which two numbers will you find $\sqrt{2}$? Since 1^2 = 1 and 2^2 =4, it is between 1 and 2. To be more precise, it is closer to 1 or 2? Systematically square 1.1, 1.2, 1.3, 1.4….. 1.9. Between which two numbers do you find 2? Repeat the process until the degree of precision you are seeking.

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Approximating Irrational Numbers Plot the square root of eight on three number lines, scaled to progressively more precision.
- Locating Irrational Numbers Graph three different irrational numbers on number lines.
- Comparing Irrational Numbers Estimate the value of several irrational numbers using a calculator and order them on a number line.
- The Irrational Beauty of the Golden Ratio Find and interpret lower and upper bounds of an irrational expression using a calculator.

Illustrative Mathematics

- Comparing Rational and Irrational Numbers Compare rational and irrational numbers without a calculator
- Irrational Numbers on the Number Line Label irrational numbers on a number line

Engaging Tasks

- Decimal Approximations of Roots - Open Middle
- Rational and Irrational Roots - Open Middle
- Number 18 – Which One Doesn't Belong

Lesson Resources

Engage NY

- Grade 8, Module 7, Topic B, Lesson 11 Decimal expansion of roots
- Grade 8, Module 7, Topic B, Lesson 12 Decimal expansions of fractions
- Grade 8, Module 7, Topic B, Lesson 13 Compare and order rational approximations

MARS/Shell

- Rational and Irrational Numbers 2 Understand the properties of rational and irrational number.

McGraw-Hill

Course 3, Chapter 1
Lesson 9; Lesson 10

Decoded Standard

MAFS.8.EE.1.1

Students learn how to compute using integer exponents building on their earlier experiences with adding and subtracting integers. For any non-zero real numbers a and b and integers n and m, the properties of integer exponents are as follows:

1. $a^m a^n = a^{m+n}$
2. $(a^n)^m = a^{nm}$
3. $a^n b^n = (ab)^n$
4. $a^0 = 1$
5. $a^{-n} = \frac{1}{a^n}$
6. $\frac{a^n}{a^m} = a^{n-m}$

(*Common Core Mathematics Companion*, Pg. 118)

Instructional Resources	
Formative Tasks **Mathematics Formative Assessments (MFAS)** • Exponents Tabled Complete a table of powers of three and provide an explanation of zero powers. • Multiplying and Dividing Integer Exponents Apply the properties of integer exponents to generate equivalent numerical expressions. **Illustrative Mathematics** • Raising to the zero and negative powers Use the quotient rule of exponents to help explain how to define the expression c^k **Engaging Tasks** • How Can We Make Stronger Passwords Determine how long it will take to crack your password.	**Lesson Resources** **Engage NY** • Grade 8, Module 1, Topic A, Lesson 1 Understanding exponential notation • Grade 8, Module 1, Topic A, Lesson 2 Simplifying exponential expressions • Grade 8, Module 1, Topic A, Lesson 3 Powers of powers • Grade 8, Module 1, Topic A, Lesson 4 Base raised to the zero power • Grade 8, Module 1, Topic A, Lesson 5 Negative exponents • Grade 8, Module 1, Topic A, Lesson 6 Integer exponents **MARS/Shell** • Applying Properties of Exponents Apply the properties of exponents by a matching activity. **McGraw-Hill** Course 3, Chapter 1 Lesson 3, 4 and 5

Decoded Standard	
MAFS.8.EE.1.2 Students learn that squaring and cubing numbers are the inverse operations to finding square and cube roots. This standard works with perfect squares and perfect cubes, and students will begin to recognize those numbers. Equations should include rational numbers such as $x^2 = \frac{1}{4}$ and $x^3 = \frac{1}{64}$ and fractions where both the numerator and denominator are perfect squares or cubes: $x^2 = \frac{1}{4}$ $\sqrt{x^2} = \pm \frac{\sqrt{1}}{\sqrt{4}}$ $x = \pm\frac{1}{2}$ Square roots can be positive or negative because 2 x 2 = 4 and -2 x -2 = 4= 4. (*Common Core Mathematics Companion*, Pg. 119)	
Instructional Resources	
Formative Tasks **Mathematics Formative Assessments (MFAS)** • The Root of the Problem Evaluate perfect square roots and perfect cube roots. • Dimension Needed Solve problems involving square roots and cube roots. • Roots and Radicals Use square root and cube root symbols to represent the real solutions of each equation. Then evaluate any square roots of perfect squares and cube roots of perfect cubes. Indicate if any of your solutions are irrational.	**Lesson Resources** **Engage NY** • Grade 8, Module 7, Topic A, Lesson 2 Square and cube roots **McGraw-Hill** Course 3, Chapter 1 Lesson 8

Decoded Standard
MAFS.8.EE.1.3 This standard emphasizes scientific notation. Students write very large and very small numbers in scientific notation using positive and negative exponents. For example 123,000 written in scientific notation is 1.23 x 10^5, and 0.008 written in scientific notation is 8 x 10^{-4}. When mastered, students use the skill to determine how many times larger (or smaller) one number written in scientific notation is than another. To compare, if the exponent increases by 1, the value increases 10 times. In the example of the U.S. and world populations, the exponent increased by 1, and the 7 is a little more than 2

times 3. So 2 x 10 makes for 20 times larger.
(*Common Core Mathematics Companion*, Pg. 120)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Estimating Extreme Values Estimate each value described below by writing it in the form $a \times 10^n$ where a is a single digit number and n is an integer.
- How Many Times Given pairs of numbers written in exponential form to compare them multiplicatively.
- Compare Numbers Given pairs of numbers written in scientific notation compare them multiplicatively.
- Order Matters Given pairs of numbers written in the form of an integer times a power of 10. Then compare the numbers in each pair using the inequality symbols.

Illustrated Mathematics

- Ant and Elephant Compare very small and very large quantities using metric system

Lesson Resources

Engage NY

- Grade 8, Module 1, Topic B, Lesson 1 Powers of 10
- Grade 8, Module 1, Topic B, Lesson 2 Translating scientific notation and standard form
- Grade 8, Module 1, Topic B, Lesson 13 Comparing numbers in scientific notation

MARS/Shell

- Applying Properties of Exponents Estimating length using scientific notation.

McGraw-Hill

Course 3, Chapter 1

Lesson 6 (supplement to express how many times larger)

Decoded Standard

MAFS.8.EE.1.4
This standard builds on previous standards as now students use what they know about scientific notation and properties of integer exponents to solve problems. Quantities in the problems can be expressed in scientific notation and decimal form. Students focus on the size of the measurement to determine which units are appropriate for the context such as millimeters for very small quantities. This standard also calls for students to use technology and be able to interpret the scientific notation used. The teacher needs to check the class calculators to be familiar with the notation used by those particular calculators as the notation used by calculators to express scientific notation is not standard.
(*Common Core Mathematics Companion*, Pg. 121)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Mixed Form Operations Given word problems with numbers in both standard and scientific notation to solve problems using various operations.
- Sums and Differences in Scientific Notation Add and subtract numbers given in scientific notation in real-world contexts.
- Scientific Multiplication and Division Multiply and divide numbers given in scientific notation in real-world contexts.
- Scientific Calculator Display Given examples of calculator displays and asked to convert the notation in the display to both scientific notation and standard form.

Engaging Tasks

- Scientific Notation – Math Mistakes

Lesson Resources

Engage NY

- Grade 8, Module 1, Topic B, Lesson 9 Operations with numbers in scientific notation
- Grade 8, Module 1, Topic B, Lesson 10 Operations with numbers in scientific notation
- Grade 8, Module 1, Topic B, Lesson 11 Operations with numbers in scientific notation
- Grade 8, Module 1, Topic B, Lesson 12 Measurement

McGraw-Hill

Course 3, Chapter 1

Lesson 7

Pre-Algebra	**Unit 2: Linear Equations in One Variable**	8 days: 8/29-9/10

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.8.EE.3.7 Solve linear equations in one variable. a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a, a = a, or\ a = b$ results (where *a* and *b* are different numbers). b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.	• Numbers in items must be rational numbers. Calculator: **YES** • Equation Editor • GRID • Matching Item • Multiple Choice • Multiselect • Open Response

Open Up Resources Lessons
Grade 8, Unit 2: Dilations, Similarity, and Introducing Slope • Lesson 10: Meet Slope • Lesson 11: Writing Equations for Lines • Lesson 12: Using Equations for Lines Grade 8, Unit 3: Linear Relationships • Lesson 1: Understanding Proportional Relationships • Lesson 2: Graphs of Proportional Relationships • Lesson 3: Representing Proportional Relationships • Lesson 4: Comparing Proportional Relationships • Lesson 5: Introduction to Linear Relationships • Lesson 6: More Linear Relationships • Lesson 7: Representations of Linear Relationships • Lesson 8: Translating to $y = mx + b$ • Lesson 9: Slopes Don't Have to be Positive • Lesson 10: Calculating Slope • Lesson 11: Equations of All Kinds of Lines

Decoded Standard
MAFS.8.EE.3.7 This standard has students solving linear equations. It is explained by 8.EE.3.7a and b. It is best to teach a and b together so that they are not considered isolated skills. These standards provide the foundation for all future work with linear equations. Students solve equations that have one, zero, or infinitely many solutions and relate those solutions to the context. If the solution is in the form $x = a$, there is only one solution. If $a = a$, there are infinitely many solutions. If $a = b$ results (where *a* and *b* are different numbers), there are no solutions. Linear equations can have fractions and decimals as coefficients and can be solved by expanding expressions with the distributive property and/or collecting like terms. (*Common Core Mathematics Companion*, Pg. 128)

Instructional Resources	
Formative Tasks	**Lesson Resources**
Mathematics Formative Assessments (MFAS) • Counting Solutions Worksheet includes three equations where students *identify* whether there is one solution, no solution, or infinitely many solutions. • Equation Prototypes Worksheet includes three questions where students are to *create* equations with one solution, no	**Engage NY** • Grade 8, Module 4, Topic A, Lesson 3 Solving equations with variables on both sides • Grade 8, Module 4, Topic A, Lesson 4 Solving equations with rational coefficients and variables on both sides

solution, and infinitely many solutions.

- Linear Equations I Students are to solve one linear equation with only one variable that involves rational numbers (fractions). $\frac{2}{3}x - 4\frac{1}{2} = -8$
- Linear Equations II Students are to solve one linear equation with only one variable that involves rational coefficients (decimals) and distributive property. $-3.5(10x - 2) = -176.75$
- Linear Equations III Students are to solve a linear equation in one variable with rational coefficients and variables on both sides of the equation. $-4(2x + 9) + 3x = 6 - 4(x - 3)$

Engaging Tasks

- Linear Equations with One Solutions Create a linear equation with one solution – Open Middle
- One Solution, No Solutions, Infinite Solutions – Open Middle
- Solving Equations – Math Mistakes
- Solving Systems Algebraically – Math Mistakes
- Number 17 – Which One Doesn't Belong

- Grade 8, Module 4, Topic A, Lesson 6 Solving equations with rational coefficients, distributive property and variables on both sides
- Grade 8, Module 4, Topic A, Lesson 7 Understanding the conditions for a=a, a=b and x=a

MARS/Shell

- Solving Linear Equations in One Variable Tasks require students to use rational coefficients, collect like terms, expand using distributive property, and categorize equations as one, none, or infinitely many solutions. Whole class instruction, small group and assessment tasks are available.)
- Classifying Solutions to Systems of Equations . Tasks require students to classify solutions that are represented graphically and use substitution to complete a table of values for linear equations.

McGraw-Hill

Course 3, Chapter 2

Inquiry Lab: Equations with Variables on Each Side; Lesson 4 and 5

Pre-Algebra	Unit 3: Linear Equations in Two Variables	10 days: 9/11-9/24

Standards/Learning Goals:	Content Limits, Assessment Types, Calculator
MAFS.8.EE.2.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*	• Numbers in items must be rational numbers Calculator: **YES** • Equation Editor • GRID • Matching Item • Multiple Choice • Multiselect • Open Response
MAFS.8.EE.2.6 Use similar triangles to explain why the slope *m* is the same distance between two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at *b*.	• All triangles must be right triangles and on a coordinate grid. • Numbers in items must be rational numbers. • Functions must be linear. Calculator: **YES** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.8.EE.3.8 Analyze and solve pairs of simultaneous linear equations. a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example,* $3x + 2y = 5$ *and* $3x + 2y = 6$ *have no solution because* $3x + 2y$ *cannot simultaneously be 5 and 6.* c. Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.*	• Numbers in items must be rational numbers. • Coefficients of equations in standard form must be integers. • Items written for MAFS.8.EE.3.8a must include the graph or the equations. • Equations in items written for MAFS.8.EE.3.8a must be given in slope-intercept form. Calculator: **YES** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Open Response

Open Up Resources Lessons
Grade 8, Unit 3: Linear Relationships • Lesson 12: Solutions to Linear Equations • Lesson 13: More Solutions to Linear Equations Grade 8, Unit 4: Linear Equations and Linear Systems • Lesson 1: Number Puzzles • Lesson 2: Keeping the Equation Balanced • Lesson 3: Balanced Moves • Lesson 4: More Balanced Moves • Lesson 5: Solving Any Linear Equation • Lesson 6: Strategic Solving • Lesson 7: All, Some, or No Solutions • Lesson 8: How Many Solutions?

- Lesson 9: When Are They the Same
- Lesson 10: On or Off the Line?
- Lesson 11: On Both of the Lines
- Lesson 12: Systems of Equations
- Lesson 13: Solving Systems of Equations
- Lesson 14: Solving More Systems
- Lesson 15: Writing Systems of Equations
- Lesson 16: Solving Problems with Systems of Equations

Decoded Standard

MAFS.8.EE.2.5

Students build on their work from Grade 6 with unit rates and their work with proportional relationships in Grade 7 to compare graphs, tables, and equations of liner (proportional) relationships. Students identify the unit rate as slope in graphs, tables, and equations to compare proportional relationships presented using different representations. For example, compare the unit rate in a problem about a phone bill presented in graphic form on a Cartesian plane to a phone bill from a different company where the unit rate can be found represented in an equation or table. (*Common Core Mathematics Companion*, Pg. 123)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Interpreting Slope Using a worksheet, graph a proportionate relationship (from a table of values), find and interpret slope.
- Proportional Paint Interpret a graph through a worksheet including three questions (identify unit rate, find slope, and describe how they are related).
- Compare Slopes Identify, describe, and compare the slopes of two proportional relationships given the graph of one and the equation of the other.

Illustrative Mathematics

- Who has the best job? Compare the rate of change of two functions displayed as a table and an equation.
- Peaches and Plums Reason about the relative costs per pound of the two fruits without actually knowing what the costs are.

Lesson Resources

Engage NY

- Grade 8, Module 4, Topic B, Lesson 11 Constant rate problems displayed in a graph and a table

MARS/Shell

- Buying cars Students will create, compare, and evaluate different representations of functions.
- Defining Lines by Points, Slopes and Equations Find slopes and equations using graphs and use slopes and y intercepts to derive equations

McGraw-Hill

Course 3, Chapter 3
Lesson 1

Decoded Standard

MAFS.8.EE.2.6

Students gain additional knowledge about slope in this standard as they use similar triangles to explain how the slope m of a line is the same between any two points on a given non-vertical line. Students understand positive/negative slopes, 0 slope, and undefined slopes. Through the use of similar triangles, teachers lead students to derive the general equation ($y = mx + b$) of a line and discover that m is the slope and b is the y-intercept. (*Common Core Mathematics Companion*, Pg. 124)

The similarity portion of this standard will be addressed in Unit 6.

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Slope Triangles Use similar triangles to explain why the slope is the same regardless of the points used to calculate it (worksheet uses proportionality of line segments to help students visualize concept).
- Deriving Lines II Students are asked to derive one general equation of a line (using the slope formula) with a y-intercept of (0,b).

Illustrative Mathematics

Lesson Resources

Engage NY

- Grade 8, Module 4, Topic C, Lesson 15 Interpret slope as rate of change on a graph
- Grade 8, Module 4, Topic C, Lesson 16 Use triangles to explain slope; slope formula to find slope
- Grade 8, Module 4, Topic C, Lesson 17 Find slope of a line; Transform standard form to slope intercept form
- Grade 8, Module 4, Topic C, Lesson 19 Proof that any point

- Slopes between points on a line Help students understand *why* the calculated slope will be the same for any two points on a given line.

on a line is a point on the graph of the equation of that line.

- Grade 8, Module 4, Topic C, Lesson 20 Any line is the graph of a linear equations
- Grade 8, Module 4, Topic C, Lesson 23 Solving systems with equations in different forms

MARS/Shell

- Defining Lines, by Points, Slopes, and Equations Find slopes and equations with ordered pairs; calculate and use slope and y-intercept to derive an equation. May involve similar triangles to help define slope.

McGraw-Hill

Course 3, Chapter 3

Lesson 4

Decoded Standard

MAFS.8.EE.3.8

This standard has students solving simultaneous linear equations. It is explained by 8.EE.3.8a-c. It is best to consider a, b, and c together as they are not isolated skills.

Students will understand that points of intersection are the solutions to pairs of simultaneous linear equations (also known as systems of linear equations). Students will solve systems graphically, algebraically, and by inspection. Examples in this standard are in real-world contexts and mathematical problems. (*Common Core Mathematics Companion*, Pg. 129)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Identify the Solution Two graphs are given; students are to identify the solutions of the system and justify their answer.
- Solving Systems of Linear Equations Three problems are given; students are asked to solve each algebraically (equations are written in both standard form and slope-intercept form).
- Solving Systems of Linear Equations by Graphing Solve one system of equation problem graphically (written in slope-intercept form), write the solution as an ordered pair and explain why it is the solution.
- How Many Solutions? Determine the number of solutions for each of the four systems of linear equations *without* solving (standard form and slope-intercept form) and justify the answer.
- Writing System Equations Two word problems are given. Students are asked to write a system of linear equations that could be used to solve them.
- System Solutions One word problem (real world context) with both equations provided. Students are to solve the system of linear equations (elimination or substitution).

Engaging Tasks

- Candy and Chips Solve the system to determine the cost of a new order of chips and candy.
- Solutions of Two Linear Equations Given a graphic, provide 4 points that represent 2 distinct lines
- Create a System of Equations, Given 1 Equation and the Solution Write linear equations so that the solution of the system of that line and equation is a particular point.
- System of Equations, Special Case Infinitely Many Solutions Fill in the boxes so that there are infinitely many solutions to the system

Lesson Resources

Engage NY

- Grade 8, Module 4, Topic D, Lesson 24 Intro to Systems of Equations
- Grade 8, Module 4, Topic D, Lesson 25 Solving systems by graphing
- Grade 8, Module 4, Topic D, Lesson 26 Solving systems with parallel lines
- Grade 8, Module 4, Topic D, Lesson 27 Solving systems with no solution
- Grade 8, Module 4, Topic D, Lesson 28 Solving systems by elimination and substitution

MARS/Shell

- Solving Real Life Problems: Baseball Jerseys Tasks require students to select appropriate mathematical methods to interpret and evaluate data generated and identify a break-even point.

McGraw-Hill

Course 3, Chapter 3

Lesson 7

• Systems of Equations, Special Case No Solution Fill in the boxes so that there is no solution to the system • Solve Linear Equations with Special Cases Complete each equation with the given number of solutions	

Pre-Algebra	Unit 4: Functions	6 days: 9/25-10/3

Standards/Learning Goals:	Content Limits, Assessment Types, Calculator
MAFS.8.F.1.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.	• Function notation may not be used. • Nonlinear functions may be included for identifying a function. Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.8.F.1.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.*	• Function notation is not used. • Functions must be linear. Calculator: **YES** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.8.F.1.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function* $A = s^2$ *giving the area of a square as a function of its side length is not linear because its graph contains the points* $(1, 1), (2, 4)$ *and* $(3, 9)$, *which are not on a straight line.*	• Function notation may not be used. Calculator: **YES** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.8.F.2.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (*x*, *y*) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.	• Function notation may not be used. • Functions must be linear. • Rate of change must be simple fractions up to tenths. Calculator: **NEUTRAL** • Equation Editor • GRID • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.8.F.2.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a	• Linear or nonlinear relationships may use any of the four quadrants. • Graph descriptions move from left to right. • Functional relationships must be continuous. Calculator: **NEUTRAL**

graph that exhibits the qualitative features of a function that has been described verbally.	• Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item

Open Up Resources Lessons

Grade 8, Unit 5: Functions and Volume

- Lesson 1: Inputs and Outputs
- Lesson 2: Introduction to Functions
- Lesson 3: Equations for Functions
- Lesson 4: Tables, Equations, and Graphs of Functions
- Lesson 5: More Graphs of Functions
- Lesson 6: Even More Graphs of Functions
- Lesson 7: Connecting Representations of Functions
- Lesson 8: Linear Functions
- Lesson 9: Linear Models
- Lesson 10: Piecewise Linear Functions

Decoded Standard

MAFS.8.F.1.1

This standard is the students' introduction to functions and involves the definition of function as a rule that assigns to each input exactly one output. Students are not required to use or recognize function notation at this grade but will be able to identify functions using tables, graphs, and equations. A relationship is not a function when there is more than one y-value associated with any x-value. Using the definition, an example of a table that does not represent a function is as follows:

See tables on page 139 of the Common Core Mathematics Companion

(*Common Core Mathematics Companion*, Pg. 139)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- What is a Function? Definition including important properties.
- Identifying Algebraic Functions Determine if each of three equations represents a function.
- Recognizing Functions Determine whether or not each of two graphs represent functions.
- Tabulating Functions Determine whether or not tables of ordered pairs represent functions.

Illustrative Mathematics Assessment Tasks

- Foxes and Rabbits Illustrates examples of functions as well as relationships that are not functions.
- US Garbage, Version 1 Describing a linear function.
- Introduction to Linear Functions Explore the differences between linear and non-linear functions.

Engaging Tasks

- Figure This! Double or Not Would you rather work 7 days at $20 per day or be paid $2 for the first day and have your salary double every day for a week?
- 25 Billion Apps When should you start bombarding the App Store with purchases if you want to win?
- Tables of Values: Not a Function Create a table of values that is not a function
- Tables of Values: Function Create a table of values that is a function

Lesson Resources

Engage NY

- Grade 8, Module 5, Topic A, Lesson 2 Expressing functions by rule, and when input is used with the formula, the outcome is the output.
- Grade 8, Module 5, Topic A, Lesson 6 Determine if a function is linear and interpret the equation y=mx+b as a linear function

McGraw-Hill

Course 3, Chapter 4

Lesson 2

Decoded Standard

MAFS.8.F.1.2

For this standard students will compare the properties of functions. One property of functions is slope. When students are given two different functions, each represented in a different form (algebraically, graphically, in a table, or by a verbal description), students should be able to determine which function has the greater slope. An example follows:

Ruth starts with a $50 gift card for Walmart. She spends $5.50 per week to buy cat food. Let *y* be the amount left on the card and *x* represent the number of weeks.

x	y
0	50
1	44.5
2	39.00
3	33.50
4	28.00

Boyce rents bikes for $5 an hour. He also collects a non-refundable fee of $10.00 for a rental to cover wear and tear. Write the rule for the total cost (*c*) of renting a bike as a function of the number of hours (*h*) rented.

Solution: Ruth's story is an example of a function with a negative slope. The amount of money left on the card decreases each week. The graph has a negative slope of -5.5, which is the amount the card balance decreases every time Ruth buys cat food.

Boyce's bike rental is an example of a function with a positive slope. This function has a positive slope of 5, which is the amount to rent a bike for an hour. An equation for Boyce's bikes could be $c = 5h + 10$.
(*Common Core Mathematics Companion*, Pg. 140)

Instructional Resources

Formative Tasks	Lesson Resources
Mathematics Formative Assessments (MFAS) • Innovative Functions Compare the rates of change of two functions presented in different forms (an expression and a table) within a real-world context. • Speed Reading Compare the rates of change of two functions presented in different forms (an expression and a table) within a real-world context. • Competing Functions Recognize and compare the initial values of two functions represented in different ways. • This House is Mine! Compare a specific value of two functions given in different forms (a graph and a verbal description) within a real-world context. **Illustrative Mathematics Assessment Tasks** • Battery Charging Verbal and numerical descriptions of battery life as a function of time. **Engaging Tasks** • Comparing Functions Generate five ordered pairs that represent a linear function that has a greater rate of change than the graph.	**Engage NY** • Grade 8, Module 5, Topic A, Lesson 7 Compare 2 functions in different way **McGraw-Hill** Course 3, Chapter 4 Lesson 2

Decoded Standard
MAFS.8.F.1.3 In this standard students become familiar with the equation $y = mx + b$ as defining a linear function that will graph as a straight line. Students distinguish between linear (functions that graph into a straight line) and nonlinear functions (functions that do not graph into a straight line such as a curve). Note that standard form and point-slope for are not studied in this grade. (*Common Core Mathematics Companion*, Pg. 141)

Instructional Resources	
Formative Tasks	**Lesson Resources**
Mathematics Formative Assessments (MFAS) • What Am I? Describe a linear function, its graph, and the meaning of its parameters. • Explaining Linear Functions Describe defining properties of linear functions. • Nonlinear Functions Provide an example of a nonlinear function and explain why it is nonlinear. • Linear or Nonlinear? Identify a function as either linear or nonlinear and to justify their decision. **Illustrative Mathematics Assessment Tasks** • Function Rules Connect a function described by a verbal rule with corresponding values in a table.	**Engage NY** • Grade 8, Module 5, Topic A, Lesson 8 Determine whether an equation is linear or non-linear by examining the rate of change **MARS/Shell** • Meal Out Use equations to solve a problem with a restaurant check. • Linear Graphs Match equations with linear graphs. **McGraw-Hill** Course 3, Chapter 4 Lesson 4

Decoded Standard
MAFS.8.F.2.4 Students identify the rate of change (slope) and y-intercept (initial value) from tables, graphs, equations, and verbal descriptions of linear relationships. The y-intercept is the y-value when the x-value is 0. Interpretation of slope and the initial value of the function is accomplished using real-world situations. (*Common Core Mathematics Companion*, Pg. 143)

Instructional Resources	
Formative Tasks	**Lesson Resources**
Mathematics Formative Assessments (MFAS) • Construction Function Construct a function to model a linear	**Engage NY** • Grade 8, Module 6, Topic A, Lesson 1 Determine and

relationship between two quantities given two ordered pairs in context.

- Profitable Functions Write a function to model a linear relationship given its graph.
- Trekking Functions Construct a function to model a linear relationship between two quantities given a table of values.
- Smart TV Determine the rate of change and initial value of a linear function given a table of values, and interpret the rate of change and initial value in terms of the situation it models.
- Drain the Pool Determine the rate of change and initial value of a linear function when given a graph, and to interpret the rate of change and initial value in terms of the situation it models.

Illustrative Mathematics Assessment Tasks

- Video Streaming Model of a linear function.
- High School Graduation Estimating approximate time name called using a linear function.
- Baseball Cards Interpreting linear functions.

interpret a linear function from a verbal description

- Grade 8, Module 6, Topic A, Lesson 2 Interpret slope and the initial value; describe the graph of the function based on its slope.
- Grade 8, Module 6, Topic A, Lesson 3 Graph a line based on different characteristics (function, initial value, points

MARS/Shell

- Lines and Linear Functions Interpret speed as the slope of a linear graph and translate between the equation of a line and its graphical representation.
- Interpreting Time-Distance Graphs Interpret distance–time graphs as if they are pictures of situations rather than abstract representations of them.

McGraw-Hill

Course 3, Chapter 4

Lesson 1

Decoded Standard

MAFS.8.F.2.5

Given a graph, students will provide a verbal description of the function, including whether the graph is linear or nonlinear or where the function is increasing or decreasing. Given a function's verbal description, students will be able to sketch the graph displaying qualitative properties of that function. The quantitative features of the graph are not displayed (specific quantities on the axes). (*Common Core Mathematics Companion*, Pg. 144)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Jet Fuel Describe the relationship between two linearly related quantities.
- Population Trend Describe the relationship between two quantities in a nonlinear function.
- Graph the Ride Given a verbal description of the relationship between two quantities and are asked to sketch a graph to model the relationship.
- Bacterial Growth Graph Given a verbal description of the relationship between two quantities and are asked to sketch a graph to model the relationship.

Illustrative Mathematics Assessment Tasks

- Tides Interpreting the graph of a function in terms of the relationship between quantities that it represents.
- Distance Interpret two graphs that look the same but show very different quantities.
- Bike Race Interpret two distance-time graphs in terms of the context of a bicycle race.

Engaging Tasks

- Joules Three Acts Math - Do you think Joules will work as advertised?

Lesson Resources

Engage NY

- Grade 8, Module 6, Topic A, Lesson 4 Describe and sketch qualitatively function relationships.
- Grade 8, Module 6, Topic A, Lesson 5 Qualitatively sketch and describe function relationship

MARS/Shell

- Modeling Situation with Linear Equations Explore relationships between variables in everyday situations.

McGraw-Hill

Course 3, Chapter 4

Lesson 9

Pre-Algebra	**Unit 5: Triangles and Pythagorean Theorem**	8 days: 10/4-10/16

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.8.G.1.5 Use informal arguments to establish facts about the angle sum & exterior angle of triangles and about the angle created when parallel lines are cut by a transversal. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.*	• Do not include shapes beyond triangles. Calculator: **NEUTRAL** • Equation Editor • GRID • Multiple Choice • Multiselect • Open Response
MAFS.8.G.2.6 Explain a proof of the Pythagorean Theorem and its converse.	• For the converse, use only perfect roots. Calculator: **YES** • Editing Task Choice • Equation Editor • GRID • Hot Text • Multiple Choice • Multiselect • Open Response
MAFS.8.G.2.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.	• If the triangles is part of a 3-dimensional figure, a graphic of the 3-dimensional figure must be included. • No coordinate plane items should be included. • Points on the coordinate grid must be where grid lines intersect. Calculator: **YES** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect
MAFS.8.G.2.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.	• Graphics of 3-dimensional figures can be included. • Dimensions must be given as rational numbers. • Figures must not be composite. Calculator: **YES** • Editing Task Choice • Equation Editor • GRID • Hot Text • Multiple Choice • Multiselect

Open Up Resources Lessons
Grade 8, Unit 1: Rigid Transformations and Congruence • Lesson 14: Alternate Interior Angles • Lesson 15: Adding the Angles in a Triangle • Lesson 16: Parallel Lines and the Angles in a Triangle Grade 8, Unit 8: Pythagorean Theorem and Irrational Numbers • Lesson 1: The Areas of Squares and Their Side Lengths • Lesson 2: Side Lengths and Areas • Lesson 3: Rational and Irrational Numbers • Lesson 4: Square Roots on the Number Line • Lesson 5: Reasoning About Square Roots • Lesson 6: Finding Side Lengths of Triangles

- Lesson 7: A Proof of the Pythagorean Theorem
- Lesson 8: Finding Unknown Side Lengths
- Lesson 9: The Converse
- Lesson 10: Applications of the Pythagorean Theorem
- Lesson 11: Finding Distances in the Coordinate Plane

Decoded Standard

MAFS.8.G.1.5

Students are expected to make informal arguments while exploring facts about the sum of the angles of a triangle, exterior angles of triangles, angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similar triangles. The example demonstrates how these facts are interrelated. Note that formal two-column proofs are not expected at this grade.

See image on page 184 of the Common Core Mathematics Companion.

(*Common Core Mathematics Companion*, Pg. 184)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Same Side Interior Angles Given same side interior angles, describe relationship and provide justification when not required to find angle measurement.
- Justifying Angle Relationships Describe the relationship between alternate interior angle and provide justification.
- Justifying the Exterior Angle Theorem Justify when it is not required to find angle measurement.
- What is the Triangle Relationship? Describe the relationship between similar triangles.
- Justifying the Triangle Sum Theorem Provide proof using a triangle.

Illustrative Mathematics

- Congruence of Alternate Interior Angles via Rotations Experiment with rigid motions to help visualize why alternate interior angles (made by a transverse connecting two parallel lines) are congruent.
- Find the Angle The task is an example of a direct but non-trivial problem in which students have to reason with angles and angle measurements (and in particular, their knowledge of the sum of the angles in a triangle) to deduce information from a picture.

Engaging Tasks

- Transversals, Tape and Stickies Place sticky notes in their assigned location based on a description

Lesson Resources

Engage NY

- Grade 8, Module 2, Topic C, Lesson 12 Understand equivalent angle relationships when lines are parallel. Understand angle relationships related to translations and rotations. Present informal arguments about angles formed from parallel lines cut by a transversal.
- Grade 8, Module 2, Topic C, Lesson 13 Informal arguments about Angle Sum Theorem for triangles
- Grade 8, Module 2, Topic C, Lesson 14 Informal proof of angle sum theorem. Find missing angle measures and prove their answer is correct.
- Grade 8, Module 3, Topic B, Lesson 10 Informal proof of Angle-Angle criterion and whether or not triangles are similar

MARS/Shell

- Identifying Similar Triangles Categorize diagrams of pairs of triangles based on their similarity.

McGraw-Hill

- Course 3, Chapter 5
  - Lesson 3 (review vocabulary pg. 372)

Decoded Standard

MAFS.8.G.2.6

There are many proofs of the Pythagorean Theorem. Students will work through one to understand the meaning of $a^2 + b^2 = c^2$ and its converse. The converse statement is as follows.: If the square of one side o a triangle is equal to the sum of the squares of the other two sides, then the triangle is a right triangle. (*Common Core Mathematics Companion*, Pg. 186)

Instructional Resources

Formative Tasks	**Lesson Resources**

Mathematics Formative Assessments (MFAS)	Engage NY
• Pythagorean Squares Demonstrate knowledge of the square root and right triangle in the Pythagorean theorem. • Explaining a Proof of the Pythagorean Theorem Proof of similar triangles. • Converse of the Pythagorean Theorem Teacher scenario to prove that the teacher is correct and prove that triangles are congruent. **Engaging Tasks** • How can we correct the Scarecrow How can we correct the Scarecrow's statement so it is mathematically precise?	• Grade 8, Module 2, Topic D, Lesson 15 Know the Pythagorean Theorem, show an informal proof of the theorem and use it to find the length of a hypotenuse. • Grade 8, Module 7, Topic C, Lesson 15 Explain the proof of the Pythagorean Theorem. • Grade 8, Module 7, Topic C, Lesson 16 Explain the proof of the converse of the Pythagorean Theorem. **MARS/Shell** • The Pythagorean Theorem: Square Areas Use the area of right triangles to deduce the areas of other shapes. **McGraw-Hill** Course 3, Chapter 5 Inquiry Lab: Proofs about Pythagorean Theorem

Decoded Standards	
MAFS.8.G.2.7 Students solve problems where they must apply the Pythagorean Theorem. Problems may be real-world or mathematical, and they may involve two- and three-dimensional situations. (*Common Core Mathematics Companion*, Pg. 187)	
Instructional Resources	
Formative Tasks	**Lesson Resources**
Mathematics Formative Assessments (MFAS) • New Television Using the measurement given, show if the TV can fit in the space provided. • How Far to School Use the Pythagorean theorem to find distance. • Three Dimensional Diagonal Apply the Pythagorean theorem to a rectangular prism's diagonal. • Pyramid Height Find the height of a pyramid. **Illustrative Mathematics** • Running on the Football Field Reason how to use the Pythagorean Theorem to find the distance ran by Ben Watson and Champ Bailey. • Area of a Trapezoid Decompose the given trapezoid into other polygons and use the Pythagorean Theorem to find the unknown side-lengths of a trapezoid in order to determine the area. • Spiderbox Visualize and apply the Pythagorean Theorem to determine the length of a spider's path around the outside of a box. **Engaging Tasks** • Viewmongous TV Is the 80" TV double, triple or quadruple the viewing area of a 55' TV? • Pythagorean Theorem Problems Math Mistakes examines several student errors with utilizing the Pythagorean Theorem.	**Engage NY** • Grade 8, Module 2, Topic D, Lesson 16 Use Pythagorean Theorem to find missing side lengths. • Grade 8, Module 7, Topic C, Lesson 17 Use the Pythagorean Theorem to determine the distance between two points on a coordinate plane. • Grade 8, Module 7, Topic C, Lesson 18 Apply the Pythagorean Theorem to real world and mathematical problems in two dimensions **McGraw-Hill** Course 3, Chapter 5 Lesson 6

Decoded Standards	
MAFS.8.G.2.8 Use the Pythagorean Theorem to find the distance between two points. Problems can best be modeled in a coordinate system. (*Common Core Mathematics Companion*, Pg. 188)	
Instructional Resources	
Formative Tasks **Mathematics Formative Assessments (MFAS)** • Distance Between Two Points Find the distance between two points on a coordinate grid. • Distance on the Coordinate Plane Find the distance between two points on a coordinate plain. • Coordinate Plane Triangle Graph the given coordinates and find the lengths of each side of the triangle. • Calculate Triangle Sides Graph the given coordinates to find the lengths of each side of the triangle. **Engaging Tasks** • Where's the Nearest Toys R Us? Determine how store locators measure distance and calculate several distances. • Pythagorean Theorem Problems Math Mistakes examines several student errors with utilizing the Pythagorean Theorem	**Lesson Resources** **Engage NY** • Grade 8, Module 7, Topic C, Lesson 17 Use the Pythagorean Theorem to determine the distance between two points on a coordinate plane. • Grade 8, Module 7, Topic C, Lesson 18 Apply the Pythagorean Theorem to real world and mathematical problems in two dimensions **McGraw-Hill** Course 3, Chapter 5 Lesson 7

Pre-Algebra	**Unit 6: Transformations, Congruence and Similarity**	12 days: 10/17-11/1

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.8.G.1.1 Verify experimentally the properties of rotations, reflections, and translations: a. Lines are taken to lines, and line segments to line segments of the same length. b. Angles are taken to angles of the same measure. c. Parallel lines are taken to parallel lines.	• Assessed though MAFS.8.G.1.2, MAFS.8.G.1.4 Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.8.G.1.2 Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.	• The coordinate plane should not be used until (8.G.1.3). • Limit sequences to no more than two transformations. • A pre-image and image should not include apostrophe notation as this would give away the identification of similarity and congruence. • No reference to the definition of congruence or symbols relating to the definition should be used (HS Geometry). Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.8.G.1.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.	• Coordinate values of *x* and *y* must be integers. • The number of transformations should be no more than two. • In items that require the student to draw a transformed figure using a dilation or a rotation, the center of the transformation must be given. Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.8.G.1.4 Understand that a two-dimensional figure is similar to	• Items should not include the coordinate plane as the coordinate plane is needed in

another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.	8.G.1.3. • Limit the sequence to no more than two transformations. • 2-dimensional figures are limited to no more than 7 sides. • A pre-image or image should not include apostrophe notation as this would give away the identification of similarity and congruence. • No reference to the definition of congruence or symbols relating to the definition should be used (HS Geometry). Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.8.G.1.5 Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angle created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.*	• Do not include shapes beyond triangles. Calculator: **NEUTRAL** • Equation Editor • GRID • Multiple Choice • Multiselect • Open Response
MAFS.8.EE.2.6 Use similar triangles to explain why the slope *m* is the same between two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at *b*.	• All triangles must be right triangles and on a coordinate grid. • Numbers in items must be rational numbers. • Functions must be linear. Calculator: **YES** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item

Open Up Resources Lessons
Grade 8, Unit 1: Rigid Transformations and Congruence • Lesson 1: Moving in the Plane • Lesson 2: Naming the Moves • Lesson 3: Grid Moves • Lesson 4: Making the Moves • Lesson 5: Coordinate Moves • Lesson 6: Describing Transformations • Lesson 7: No Bending or Stretching • Lesson 8: Rotation Patterns

- Lesson 9: Moves in Parallel
- Lesson 10: Composing Figures
- Lesson 11: What is the Same?
- Lesson 12: Congruent Polygons
- Lesson 13: Congruence

Grade 8, Unit 2: Dilations, Similarity, and Introducing Slope

- Lesson 1: Projecting and Scaling
- Lesson 2: Circular Grid
- Lesson 3: Dilations with no Grid
- Lesson 4: Dilations on a Square Grid
- Lesson 5: More Dilations
- Lesson 6: Similarity
- Lesson 7: Similar Polygons
- Lesson 8: Similar Triangles
- Lesson 9: Side Length Quotients in Similar Triangles

Decoded Standard

MAFS.8.G.1.1 – students need multiple opportunities to explore the transformation of figures

Eighth graders add rotations, reflections, and translations to their study of transformations from Grade 7 dilations. Students verify through experimentation with figures on a coordinate plane that lines are taken to lines and line segments to line segments of the same length; angles are taken to angles of the same measure, and parallel lines are taken to parallel lines. This standard is an introduction, and students should spend time exploring these transformations.

See image on page 178 of the Common Core Mathematics Companion.

(*Common Core Mathematics Companion*, Pg. 178)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Segment Transformations Translation, rotation, and reflection
- Angle Transformations Students will need rulers and transparent paper. Students experimentally verify the properties of angle transformations.
- Parallel Line Transformations Students experimentally verify properties of parallel lines transformation.

Engaging Tasks

- How did they make Ms. Pac-Man Describe Ms. Pac-Man's movements with academic vocabulary
- How do Skytypers Write Messages? Use transformation applications to create skytyping messages and translate it into a set of coordinates.
- Naming Coordinates, Feedback and Revision Revise a student error involving translating a quadrilateral
- Best Reflection Students compare 4 images with their reflection to determine which one is the best.
- Pool Bounce Determine where each shot will hit using reflections.
- Transformations – Shortest Sequence What's the fewest number of transformations needed to take pre-image ABCT to A'B'C'D'.

Lesson Resources

Engage NY

- Grade 8, Module 2, Topic A, Lesson 1
  Rigid Motion
- Grade 8, Module 2, Topic A, Lesson 2
  Translations
- Grade 8, Module 2, Topic A, Lesson 3
  Parallel Lines
- Grade 8, Module 2, Topic A, Lesson 4
  Reflections
- Grade 8, Module 2, Topic A, Lesson 5
  Rotations

MARS/Shell

- Representing and Combining Transformations
  Combining rigid transformations

McGraw-Hill

Course 3, Chapter 6

Inquiry Lab: Transformations
Lesson 1, 2 and 3

Course 3, Chapter 7

Lesson 1

Decoded Standard

MAFS.8.G.1.2
Students use what they previously learned about transformations to determine congruency between figures. Congruent figures share the same size and shape. When given two congruent figures, students describe the sequence of transformations that occurred to create the congruent figure. Note that dilations cannot be used for congruent figures. (*Common Core Mathematics Companion*, Pg. 180)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Proving Congruence Students are asked to explain congruence in terms of rigid motions.
- Rigid Motion 1 Students are asked to describe the motion and determine if the shapes are congruent. Translation
- Rigid Motion II-Reflection Describe a rigid motion to demonstrate two polygons are congruent.
- Rigid Motion III Describe a rigid motion to demonstrate two polygons are congruent.
- Multistep Congruence Describe a sequence of rigid motions to demonstrate the congruence of two polygons.

Illustrative Mathematics

- Cutting a Rectangle Into Two Shows the congruence of two triangles in a particular geometric context arising by cutting a rectangle in half along the diagonal.
- Congruent Triangles Develop an understanding of rigid motions in the context of demonstrating congruence and reflections refined by orientation.

Engaging Tasks

- Naming Coordinates, Feedback and Revision Revise a student error involving translating a quadrilateral
- Best Reflection Students compare 4 images with their reflection to determine which one is the best.
- Transformations – Shortest Sequence What's the fewest number of transformations needed to take pre-image ABCT to A'B'C'D'.
- Transformations – Three Sequences List three sequences of transformations that take pre-image ABCT to image A'B'C'D'

Lesson Resources

Engage NY

- Grade 8, Module 2, Topic B, Lesson 10
  Mapping one figure onto another
- Grade 8, Module 2, Topic C Lesson 11
  Congruence through Rigid Motion

MARS/Shell

- Transforming 2D Figures Describe in words the transformation that maps an object to a transformed image. Given a geometric figure and a rotation, reflection or translation, draw the transformed figure (or the original figure if the image is given.) Describe transformations as algebraic functions that take points in the plane as inputs and give other points as outputs.

McGraw-Hill

Course 3, Chapter 7
Lesson 2

Decoded Standard

MAFS.8.G.1.3
Students continue looking at two-dimensional figures on the coordinate plane, concentrating on the coordinates of the resulting figure after transformations, including dilations learned in Grade 7.
(*Common Core Mathematics Companion*, Pg. 181)

Instructional Resources

Formative Tasks	**Lesson Resources**
Mathematics Formative Assessments (MFAS) • Translation Coordinates Two problems both require students to graph a two-dimensional figure's translation and identify the new coordinates. • Rotation Coordinates Two problems both require students to graph a two-dimensional figure's rotation and identify the new coordinates. • Reflection Coordinates Two problems both require students to graph a two-dimensional figure's reflection and identify the new coordinates. **Engaging Tasks** • How do Skytypers Write Messages? Use transformation applications to create skytyping messages and translate it into a set of coordinates. • Naming Coordinates, Feedback and Revision Revise a student error involving translating a quadrilateral • Transformations – Shortest Sequence What's the fewest number of transformations needed to take pre-image ABCT to A'B'C'D'. • How did they make Ms. Pac-Man Describe Ms. Pac-Man's movements with academic vocabulary	**Engage NY** • Grade 8, Module 3, Topic A, Lesson 6 Dilations using Coordinates **MARS/Shell** • Representing and Combining Transformations Students will recognize and visualize transformations of 2D shapes. They will translate, reflect and rotate shapes, and combine these transformations. **McGraw-Hill** Course 3, Chapter 6 Lesson 1 (Translations), Lesson 2 (Reflections), Lesson 3 (Rotations) and Lesson 4 (Dilations)

Decoded Standard
MAFS.8.G.1.4 With this standard, students move from congruence to similarity. Students develop the understanding that similar figures can be created by a series of transformations, including rotations, reflections, dilations, and translation, and can identify those transformations given an image and a pre-image. See image on page 182 of the Common Core Mathematics Companion. (*Common Core Mathematics Companion*, Pg. 182)

Instructional Resources

Formative Tasks	**Lesson Resources**
Mathematics Formative Assessments (MFAS) • Proving Similarity Explain similarity in terms of transformations • Similarity I Describe a sequence of transformations to show that two polygons are similar. • Similarity II Describe a sequence of transformations to show that two polygons are similar. • Similarity III Describe a sequence of transformations that demonstrates two polygons are similar. **Illustrative Mathematics** • Are they Similar? Provide experience applying transformations to show that two polygons are similar. • Creating Similar Triangles Provide experience applying transformations to show that two polygons are similar. **Engaging Tasks** • Right Triangles – Trapezoids What question comes to mind for the given image?	**Engage NY** • Grade 8, Module 2, Topic B, Lesson 7 Sequencing transformations that enjoy the same properties as a single translation with respect to lengths of segments and angle degrees. • Grade 8, Module 3, Topic B, Lesson 8 Sequence of Transformations that lead to Similarity **McGraw-Hill** Course 3, Chapter 7 Lesson 4

Decoded Standard
MAFS.8.G.1.5

Students are expected to make informal arguments while exploring facts about the sum of the angles of a triangle, exterior angles of triangles, angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similar triangles. The example demonstrates how these facts are interrelated. Note that formal two-column proofs are not expected at this grade.

See image on page 184 of the Common Core Mathematics Companion.

(*Common Core Mathematics Companion*, Pg. 184)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Same Side Interior Angles Describe and justify the relationship between same side interior angles.
- Justifying Angle Relationships Describe and justify the relationship between corresponding angles and alternate interior angles
- Justifying the Exterior Angle Theorem Apply the Exterior Angle of a Triangle Theorem and provide an informal justification
- What is the Triangle Relationship? Describe the relationship between two triangles given that two pairs of corresponding angles are congruent, and provide an informal justification of the relationship (similarity).
- Justifying the Triangle Sum Theorem Provide an informal justification of the Triangle Sum Theorem

Illustrative Mathematics

- Rigid motions and congruent angles Given parallel lines cut by a transversal, prove congruence between angle pairs.
- A Triangle's Interior Angles Given parallel lines with a triangle drawn with its transversals, prove that a+b+c = 180
- Find the Missing Angle Find the measure of a missing angle between parallel lines
- Congruence of Alternate Interior Angles via Rotations Explain why rotating a pair of parallel lines cut by a transversal demonstrates that angles are congruent.
- Street Intersections Apply facts about angles in order to calculate angle measures in the context of a map.

Lesson Resources

Engage NY

- Grade 8, Module 2, Topic C, Lesson 12
  Angle Relationships of Parallel Lines
- Grade 8, Module 2, Topic C, Lesson 13
  Angle Sum Theorem Triangles
- Grade 8 Module 2, Topic C, Lesson 14
  Missing Angle Measures Triangles

McGraw-Hill

Course 3, Chapter 7
Lesson 5

Decoded Standard

MAFS.8.EE.2.6

Students gain additional knowledge about slope in this standard as they use similar triangles to explain how the slope *m* of a line is the same between any two points on a given non-vertical line. Students understand positive/negative slopes, 0 slope, and undefined slopes. Through the use of similar triangles, teachers lead students to derive the general equation ($y = mx + b$) of a line and discover that *m* is the slope and *b* is the y-intercept. (*Common Core Mathematics Companion*, Pg. 124)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Slope with similar Triangles Use similar triangles to explain why the slope is the same regardless of the points used to calculate it.
- Deriving Lines I- Using the slope formula Derive the general equation of a line containing the origin.
- Deriving Lines II Using the slope formula Derive the general equation of a line with a *y*-intercept of (0, *b*)

Lesson Resources

Engage NY

- Grade 8, Module 4, Topic C, Lesson 16 Use similar triangles to explain slope and calculate the slope between two distinct points on a non-vertical line.

McGraw-Hill

Course 3, Chapter 7
Lesson 6

Illustrative Mathematics • Slopes between points on a line Understand why the calculated slope will be the same for any two points on a given line.	

Pre-Algebra	**Unit 7: Volume**	8 days: 11/4-11/13

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.8.G.3.9 Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.	• Graphics of three-dimensional figures can be included. • Dimensions must be given as rational numbers. • Figures must not be composite Calculator: **YES** • Equation Editor • Multiple Choice • Multiselect

Open Up Resources Lessons

Grade 8, Unit 5: Functions and Volume

- Lesson 11: Filling Containers
- Lesson 12: How Much Will Fit?
- Lesson 13: The Volume of a Cylinder
- Lesson 14: Finding Cylinder Dimensions
- Lesson 15: The Volume of a Cone
- Lesson 16: Finding Cone Dimensions
- Lesson 17: Scaling One Dimension
- Lesson 18: Scaling Two Dimensions
- Lesson 19: Estimating a Hemisphere
- Lesson 20: The Volume of a Sphere
- Lesson 21: Cylinders, Cones, and Spheres

Decoded Standard

MAFS.8.G.3.9

This standard has two distinct parts. First, students learn the volume formulas for cones, cylinders, and spheres. Then they apply this knowledge to solve real-world and mathematical problems. The formulas should be taught through experiments where students figure out the formulas. (*Common Core Mathematics Companion*, Pg. 190)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Cone Formula Write the formula for the volume of a cone, explain what each variable represents, and label the variables on a diagram.
- Cylinder Formula Write the formula for the volume of a cylinder, explain what each variable represents, and label the variables on a diagram.
- Sphere Formula Write the formula for the volume of a sphere, explain what each variable represents, and label the variables on a diagram.
- Sugar Cone Solve a problem that requires calculating the volume of a cone.
- Platinum Cylinder Solve a problem that requires calculating the volume of a cylinder.
- Burning Sphere Solve a problem that requires calculating the volume of a sphere.

Illustrative Mathematics Assessment Tasks

- Comparing Snow Cones Find the volume of a cone.
- Glasses Use volume formulas for cylinders, cones and spheres.
- Flower Vases Use volume formulas for cylinders, cones and spheres.

Lesson Resources

Engage NY

- Grade 8, Module 5, Topic B, Lesson 10
  Volume of Cylinders and Cones; Solve real-world volume problems
- Grade 8, Module 5, Topic B, Lesson 11
  Volume of Spheres; Solve real-world volume problems

McGraw-Hill

Course 3, Chapter 8

Lesson 1 (Cylinders), Lesson 2 (Cones – skip ex. 3), and Lesson 3 (Spheres – skip ex. 4)

Pre-Algebra	Unit 8: Scatter Plots and Data Analysis	7 days: 11/14-11/22

Standards/Learning Goals:	Content Limits, Assessment Types, Calculator
MAFS.8.SP.1.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.	• Numbers in items must be rational numbers. Calculator: **NEUTRAL** • GRID • Multiple Choice • Multiselect
MAFS.8.SP.1.2 Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.	• Numbers in items must be rational numbers. • Trend/association is based on visual inspection. • Line of best fit must be informally assessed. • Trend/association must be linear. Calculator: **NEUTRAL** • GRID • Multiple Choice • Multiselect • Open Response
MAFS.8.SP.1.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope an intercept. *For example, in a linear model for a biology experiment, interpret a slop of 1.5 cm/hr. as meaning that an additional hour of sunlight each day is associated with an additional 1.5cm in mature plant height.*	• Numbers in items must be simple rational numbers (e.g., ½, ¼, to the 10th). • Data are required for all items. • In all items requiring a line of best fit, the equation of that line should be given. Calculator: **NEUTRAL** • Equation Editor • Multiple Choice • Multiselect • Open Response
MAFS.8.SP.1.4 Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?*	• Numbers in items must be rational numbers. • Data given should include the grand total of the survey. • Tables must not include more than two columns (plus category and total) and two rows (plus category and total). Calculator: **YES** • Equation Editor • GRID • Multiple Choice • Multiselect • Table Item

Open Up Resources Lessons

Grade 8, Unit 6: Associations in Data

- Lesson 1: Organizing Data
- Lesson 2: Plotting Data
- Lesson 3: What a Point in a Scatter Plot Means
- Lesson 4: Fitting a Line to Data
- Lesson 5: Describing Trends in Scatter Plots
- Lesson 6: The Slope of a Fitted Line
- Lesson 7: Observing More Patterns in Scatter Plots
- Lesson 8: Analyzing Bivariate Data
- Lesson 9: Looking for Associations
- Lesson 10: Using Data Displays to Find Associations

Decoded Standard

MAFS.8.SP.1.1

Students study scatter plots of bivariate data by constructing and interpreting them in terms of patterns they can see. They look for the patterns of clustering, outliers, positive or negative association, and linear or nonlinear association. Examples of scatter plots below show positive and negative associations, clustering, and an outlier.

See the image on page 238 of the Common Core Mathematics Companion

(*Common Core Mathematics Companion*, Pg. 238)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Sleepy Statistics Describe the association between scores on the Epworth Sleepiness Scale and scores on the math test.
- Population Density Describe the relationship between population and land area.
- Infectious Statistics Describe the association between the passage of time and the number of bacteria.
- Cheesy Statistics Describe the association between time spent watching advertisements and the percent of each group willing to buy the company's cheese crackers.
- Bungee Cord Data Construct a scatterplot corresponding to a given set of data.

Illustrative Mathematics Assessment Tasks

- Birds' Eggs Identify a correlation and use it to make interpolative predictions.
- Texting and Grades I Describe the relationship between number of text messages sent and GPA.

Engaging Tasks

- Positive Correlation Create a set of points that have specific characteristics
- Interpreting Graphs Where Up Isn't Good Interpret data on a scatterplot that appears unconventional.

Lesson Resources

Engage NY

- Grade 8, Module 6, Topic B, Lesson 6
  Constructing Scatter Plots
- Grade 8, Module 6, Topic B, Lesson 7
  Patterns in Scatter Plots
- Grade 8, Module 6, Topic C, Lesson 11
  Scatter plots; Fit line to data; Interpret slope

McGraw-Hill

Course 3, Chapter 9

Lesson 1

Decoded Standard

MAFS.8.SP.1.2

Students focus on linear patterns of association in scatter plots and understand that linear models (straight lines) are commonly used to model linear relationships. Then they begin to informally fit a straight line to the data and learn to assess its fit by judging the closeness of the line to the data points. The most appropriate line is the one that comes closest to most data points. The use of linear regression is not expected at this grade. (*Common Core Mathematics Companion*, Pg. 239)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Two Scatterplots Compare how well each line fits its set of data. Explain your reasoning.
- Three Scatterplots (Informally assess three lines fitted to data to determine which fit is the best.)
- Line of Good Fit I Fit a line to model the relationship between two quantitative variables and to assess how well that line fits the data.
- Line of Good Fit II See description above.

Illustrative Mathematics Assessment Tasks

- Hand Span and Height Construct and Interpret Scatter plots by

Lesson Resources

Engage NY

- Grade 8, Module 6, Topic B, Lesson 8
  Informally fit a line to data in scatter plot
- Grade 8, Module 6, Topic C, Lesson 9
  Informally fit a line to data in scatter plot
- Grade 8, Module 6, Topic C, Lesson 11
  Scatter plots; Fit line to data; Interpret slope

McGraw-Hill

Course 3, Chapter 9

Lesson 2

generating and recording data.

- Animal Brains Create scatterplots, and think critically about associations and outliers in data as well as informally fit a trend line to data.
- Laptop Battery Charge Find and use a linear model answer this question.

Engaging Tasks

- Line of Best Fit Create 4 points that could generate a line of best fit with the equation y=-x+8.

Decoded Standard

MAFS.8.SP.1.3

Students practice solving contextual linear problems. The problems involve situations using bivariate measurement data such as those collected in a biology experiment. This standard connects with what students have learned about models of linear equations, slope, and intercept. (*Common Core Mathematics Companion*, Pg. 240)

Instructional Resources

Formative Tasks

Mathematics Formative Assessments (MFAS)

- Tuition Use this equation to predict the average tuition cost at a public university.
- Stretching Statistics Explain the significance of a point and the y-intercept.
- Foot Length Interpret the slope and intercept of a linear function that models the relationship between foot length and height.
- Developmental Data Explain the significance of the slope of the equation in terms of a problem's context.

Illustrative Mathematics Assessment Tasks

- US Airports, Assessment Variation Use a linear function to model a relationship between two quantities.
- Chicken and Steak, Variation 1 Presents a real world situation that can be modeled with a linear function best suited for an instructional context

Lesson Resources

Engage NY

- Grade 8, Module 6, Topic C, Lesson 10
  Interpret slope and initial value
- Grade 8, Module 6, Topic C, Lesson 11
  Scatter plots; Fit line to data; Interpret slope

McGraw-Hill

Course 3, Chapter 9

Lesson 2

Decoded Standard

MAFS.8.SP.1.4

This standard asks students to switch from using numerical data to categorical data and use frequencies to answer questions about possible associations (linear/nonlinear, positive/negative/no association). Students construct and interpret tables that display categorical data on two different variables from the same subjects. A two-way table is a table that shows categorical data classified in two different ways. An example of a two-way table that records possible data from the example in the standard about chores and curfews may be the following:

		CURFEW	
		YES	NO
CHORES	YES	44	20
	NO	20	44

One interpretation of the chart is that of the students who answered yes, they had a curfew, 44 had chores and 20 did not. Of the students who answered no, they did not have a curfew, 20 had chores and 44 did not. From this sample, there appears to be a positive correlation between having a curfew and having chores. (*Common Core Mathematics Companion*, Pg. 214)

Instructional Resources

Formative Tasks	Lesson Resources
Mathematics Formative Assessments (MFAS) • Two-Way Relative Frequency Table Convert raw data to relative frequencies by both rows and columns given a two-way frequency table. • School Start Time Interpret data given in a two-way table. • Music and Sports Construct a two-way frequency table given a set of raw data. • Sibling and Pets Interpret data given in a two-way table. **Illustrative Mathematics Assessment Tasks** • What's Your Favorite Subject? Calculate appropriate relative frequencies using the given data. • Music and Sports Investigate the association between whether a student plays a sport and whether he or she plays a musical instrument.	**Engage NY** • Grade 8, Module 6, Topic D, Lesson 13 Two-way Tables; Row and Column Relative Frequencies • Grade 8, Module 6, Topic D, Lesson 14 Association between Two Categorical Values **MARS/Shell** • Testing a New Product Assess how well students are able to organize, represent and analyze bivariate categorical data in an appropriate way. **McGraw-Hill** Course 3, Chapter 9 Lesson 3

Algebra 1 Honors	**Unit 1: Summarize, represent, and interpret data on a single count or measurement variable.**	4 days: 12/2-12/5

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.912.S-ID.1.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).	• None Calculator: **NEUTRAL** • GRID • Hot Text • Multiple Choice • Multiselect • Open Response
MAFS.912.S-ID.1.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.	• Items may require the student to calculate mean, median, and interquartile range for the purpose of identifying similarities and differences. • Items should not require the student to calculate the standard deviation. Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response
MAFS.912.S-ID.1.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	• Items should not require the student to fit normal curves to data. • Data distributions should be approximately normal. • Data sets should be real-world and quantitative. Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response
MAFS.912.S-ID.1.4 **(Algebra 2 standard not tested)** Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve	• Students will calculate the z-score and use it to compare a data point to the population. • Students will calculate the z-score and use it to compare two data points. Calculator: **NEUTRAL** • Equation Editor • GRID • Matching Item • Multiple Choice • Multiselect • Open Response • Table item

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)

- Chapter 12: Statistics and Probability
  - Lesson 1: Samples and Studies
  - Algebra Lab: Evaluating Published Data
  - Lesson 2: Statistics and Parameters
  - Lesson 3: Distributions of Data
  - Lesson 4: Comparing Sets of Data

Standards are not to be taught in the sequence presented but as a coherent approach through thoughtful lesson planning.
Using the textbook is not always meeting the depths of the new standards that is why other resources are provided

Algebra Nation

- Data Plots
- Histograms
- Box Plots – Part 1
- Box Plots – Part 2
- Measures of Center and Shapes of Distributions
- Measures of Spread – Part 1
- Measures of Spread – Part 2
- The Empirical Rule
- Outliers in Data Sets

EngageNY Instructional Resource (may not cover all content required for the aligned standards)

- Algebra 1 Module 2, Topic A, Lesson 1
- Algebra 1 Module 2, Topic A, Lesson 2
- Algebra 1 Module 2, Topic A, Lesson 3
- Algebra 1 Module 2, Topic B, Lesson 4
- Algebra 1 Module 2, Topic B, Lesson 5
- Algebra 1 Module 2, Topic B, Lesson 6
- Algebra 1 Module 2, Topic B, Lesson 7
- Algebra 1 Module 2, Topic B, Lesson 8

Decoded Standard

MAFS.912.S-ID.1.1
Students use dot plots, histograms, and box plots to represent quantitative data collected from their world or through purposely given data sets. Though these graphs are separate, graphing them simultaneously on one number line builds a strong foundation and understanding of each.
Students describe features that each data representation possesses for the description of a particular distribution. Histograms are useful to represent distributional shape but limit the ability to determine exact measures of center and spread. The shape of histograms may change based on the chosen bin widths. Dot plots allow for the calculation of summary statistics but are tedious to draw and, if represented by numbers that are not integers, may be difficult to summarize. Box plots can emphasize the spread of a distribution by comparing the size of quartiles and can help with the understanding of skewness of a data set while being plotted simultaneously with histograms and dot plots. (*Common Core Mathematics Companion*, Pg. 351)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources
A Tomato Garden Students are asked to construct a dot plot corresponding to a given set of data Flowering Trees Students are asked to determine whether each of two given dot plots are consistent with a given histogram. Winning Season Students are asked to construct a histogram corresponding to a given set of data. Trees in the Park Students are asked to construct a box plot corresponding to a given set of data. Illustrative Mathematics Assessment Tasks Speed Trap The purpose of this task is to allow students to demonstrate	

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Using the textbook is not always meeting the depths of the new standards that is why other resources are provided

an ability to construct boxplots and to use boxplots as the basis for comparing distributions.	

Decoded Standard	
MAFS.912.S-ID.1.2 The overarching purpose of statistics is to use data to summarize, compare, and predict. This particular standard focuses on the issue of comparison between different data sets. Students are required to understand the difference between centers and spreads of two distributions. In some cases, summary information may be similar or different based on the context of the data set; thus, students are required to use and justify appropriate measure of center and spread. (*Common Core Mathematics Companion*, Pg. 353)	
Instructional Resources	
Mathematics Formative Assessments (MFAS) How Many Jeans Students are asked to select a measure of center to compare data displayed in dot plots and to justify their choice. Texting During Lunch Students are asked to select a measure of center to compare data displayed in frequency tables and to justify their choice. Texting During Lunch Histograms Students are asked to select measures of center and spread to compare data displayed in histograms and to justify their choices. Illustrative Mathematics Assessment Tasks Hair Cut Costs This problem could be used as an introductory lesson to introduce group comparisons and to engage students in a question they may find amusing and interesting.	Lesson Resources

Decoded Standard	
MAFS.912.S-ID.1.3 We often describe distributions by their center. We may identify one or multiple peaks or modes of the data set, which may or may not relate to the distribution's measure of center. Generally, the mean is best used for the measure of center if there are no extreme values or there is no skewness in the distribution. When distributions are skewed to the right or the left, the mean tends to be more towards the skew than the center of the distribution. In cases of skewed data sets or cases with extreme values, it is more appropriate to use the median as a center because it is considered robust, or less subjective to extreme values or skewness. The uniform distribution or uniform probability model may also be useful for students because it is a good model for introduction of probability models for continuous data. Students should use summaries of quantitative spread that use the relationship of dispersion and center. The interquartile range (IQR), which represents the width of the box plot, or Quartile 3 minus Quartile 1, does not use a measure of center in its calculation. For this reason, students should use the IQR as a preferred description measure when in the presence of skewness or outliers (that is, when the median is the more appropriate measure of center). Students use the standard deviation when the mean of a data set is appropriate, such as when the distribution is symmetric or when a sample is intended to measure the population mean. (*Common Core Mathematics Companion*, Pg. 354)	
Instructional Resources	
Mathematics Formative Assessments (MFAS) Using Centers to Compare Tree Heights Students are asked to compare the centers of two data distributions displayed using box plots. Using Spread to Compare Tree Heights Students are asked to compare the spread of two data distributions displayed using box plots.	Lesson Resources

Comparing Distributions Students are given two histograms and are asked to describe the differences in shape, center, and spread. Total Points Scored Students are given a set of data and are asked to determine how the mean is affected when an outlier is removed.	

Decoded Standard

MAFS.912.S-ID.1.4

This particular standard emphasizes the use of the normal distribution to obtain the probability or likelihood of certain events. Though the empirical rule is not explicitly stated, it can form a basis for the relationship understanding of area under the distribution and likelihood of occurrence. The empirical rule states that 68% of the data in a normal distribution is between 1 standard deviation below the mean and 1 standard deviation above the mean; 95% of data is between 2 standard deviations below the mean and 2 standard deviations above the mean; 99.7% of the data from a normal distribution is between 3 standard deviations below the mean and 3 standards deviations above the mean, shown below.

See the images on page 355.

The standards emphasizes the use of calculators, spreadsheets, and tables to estimate the area under the curve. Students can use functions within advanced calculators to identify boundaries of interest. For example, a problem may require finding the probability of an event being between -1 standard deviation and 1.5 standard deviations of the mean. This is an interval contained within two bounds. Intervals may be upward-bound restricted, lower-bound restricted, or both lower- and upward-bound restricted. When using tables or spreadsheets to identify areas or probability of interest, it is important to identify the table or spreadsheet design. Some tables may provide areas below or above a value of interest.

If students use tables, they will need to learn how to standardize data using data transformations. Teachers should devote attention and time to ensuring students understand the impact of operations on data sets. Addition and subtraction of a data set by the same number relates to translation. This keeps the data set shape and spread equal; however, the center shifts. Multiplication and division of the data set relates to dilation. The center and spread are numerically changed; however, the shape is equivalent. To students, the shape of the graph of the data set may appear to change during experimentation, but the shapes of the original and the transformed data are equivalent. Students can verify this when changing the scale of the transformed graph or the bin width of the histogram by the scale of the multiplier. Standardization uses these properties to transform a data set by shifting it to a center of zero and making it standard deviation 1.

(*Common Core Mathematics Companion*, Pgs. 355-356)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources
Range of testing Thread Students are asked to find the probability that an outcome of a normally distributed variable is between two given values. Label a Normal Curve Students are asked to scale and label a normal curve given the mean and standard deviation of a data set with a normal distribution. Area Under the Normal Curve Students are asked to find the probability that an outcome of a normally distributed variable is between two given values using both a Standard Normal Distribution Table and technology. Algebra Test Scores Students are asked to select a histogram for which it would be appropriate to apply the 68-95-99.7 rule. Probability of your Next Texting Thread Students are asked to find the probability that an outcome of a normally distributed variable is greater than a given value.	•

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Illustrative Mathematics Assessment Tasks	
SAT Scores This problem solving task challenges students to answer probability questions about SAT scores, using distribution and mean to solve the problem. Do You Fit in This Car? This task requires students to use the normal distribution as a model for a data distribution. Students must use given means and standard deviations to approximate population percentages	

Algebra 1 Honors	**Unit 2: Interpret linear models.**	4 days: 12/6-12/11

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.912.S-ID.3.7 In items that require the student to interpret or use the correlation coefficient, the value of the correlation coefficient must be given in the stem.	• Items assessing S-ID.3.7 should include data sets. Data sets must contain at least six data pairs. The linear function given in the item should be the regression equation. • For items assessing S-ID.3.7, the rate of change and the y-intercept should have a value with at least a hundredths place value. Calculator: **NEUTRAL** • Equation Editor • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response
MAFS.912.S-ID.3.8 Compute (using technology) and interpret the correlation coefficient of a linear fit. Assessed with MAFS.912.S-ID.2.6	• In items that require the student to interpret or use the correlation coefficient, the value of the correlation coefficient must be given in the stem. Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.912.S-ID.3.9 Distinguish between correlation and causation. Assessed with MAFS.912.S-ID.2.6	• In items that require the students to interpret or use the correlation coefficient, the value of the correlation must be given in the stem. Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)

- Chapter 4: Equations of Linear Functions
    - Algebra Lab: Correlation and Causation

Algebra Nation

- Rate of Change of Linear Functions
- Interpreting Rate of Change and Y-Intercpet in a Real-World Context – Part 1
- Interpreting Rate of Change and Y-Intercept in a Real-World Context – Part 2
- Examining Correlation

EngageNY Instructional Resource (may not cover all content required for the aligned standards)

- Algebra 1 Module 2, Topic C, Lesson 11
- Algebra 1 Module 2, Topic C, Lesson 12

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- Algebra 1 Module 2, Topic C, Lesson 13
- Algebra 1 Module 2, Topic D, Lesson 14
- Algebra 1 Module 2, Topic D, Lesson 15
- Algebra 1 Module 2, Topic D, Lesson 19
- Algebra 1 Module 2, Topic D, Lesson 20

Decoded Standard

MAFS.912.S-ID.3.7

Students interpret slope from a given linear model in terms of units of increase of the *x* variable and the associated increase or decrease on the *y* variable. For a positive slope, students describe how a specific increase in the *x* variable contributes to a certain increase in the *y* variable (in context). For a negative slope, students relate the increase in the *x* variable (in context of the situation) with a decrease in the *y* variable. For every 1 unit of increase in the *x* variable, the *y* variable will increase of decrease the amount and direction of the slope.
The intercept of a linear model cannot always be interpreted within a context. A correct interpretation discusses the *y* variable in context when the *x* variable in context is zero. If the *x* variable cannot contextually be zero or close to zero, students should address the inappropriateness of interpretation. In addition, the *y* intercept may be far from the points in the data set and be useless for prediction (and is considered a case of unwarranted extrapolation). (*Common Core Mathematics Companion*, Pg. 369)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Additional Lesson Resources
Intercept for Life Expectancy Students are asked to interpret the intercept of a linear model of life expectancy data. Slope for Foot Length model Students are asked to interpret the meaning of the slope of the graph of a linear model. Slope For Life Expectancy Students are asked to interpret the meaning of the slope of the graph of a linear model. Bungee Cord Model Students are asked to interpret the meaning of the constant term in a linear model.	

Decoded Standard

MAFS.912.S-ID.3.8

Students use technology to compute the correlation coefficient of a linear fit. This is a measure of the strength and direction of the linear relationship between two variables, or the correlation coefficient (*r*). A model is said to be perfectly positively related when the *r* value is 1 and perfectly negatively related when the *r* value is -1. No linear association would be represented with an *r* value of 0. Some common interpretations for specific *r* values are in the table below but are not a gold standard. Tables such as this should not be used alone but in conjunction with the scatter and residual plots to determine appropriate fit.

|*r* value|	Description
.0-.19	Very weak
.2-.39	Weak
.4-.59	Moderate
.6-.79	Strong
.8-1.0	Very Strong

Students can model correlation coefficient by visually displaying points' relationships to both their independent and dependent variables' mean using vertical and horizontal lines. Though not a part of this standard, the calculation of the correlation coefficient is the slope of the line when the *x* and *y* have been standardized or shifted to an intercept of (0, 0) with both *x* and *y* having standard deviation 1.

See Pgs. 371-372 for more information.

(*Common Core Mathematics Companion*, Pgs. 371-372)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Additional Lesson Resources
July December Correlation Students are asked to compute and interpret the correlation coefficient for a given set of data. How Big are Feet Students are asked to compute and interpret the correlation coefficient for a given set of data. Correlation Order Students are asked to estimate a correlation coefficient for each of four data sets and then order the coefficients from least to greatest in terms of the strength of relationship. Correlation for Life Expectancy Students are asked to compute and interpret the correlation coefficient for a given set of data.	

Decoded Standard

MAFS.912.S-ID.3.9

Data alone cannot be used to determine causation; thus, experimentation and science is involved to help deduce causation. Students and the teacher should pay careful attention to terminology used when describing bivariate relationships (both quantitative versus quantitative, quantitative versus categorical, and categorical versus categorical), even when causal effects seem evident. In order to determine causation to a population or from a treatment, at the least, researchers must complete a random sampling from the population and a random assignment to the treatment group. In many situations, this is impossible and unethical.

Teachers can exemplify this standard with the use of two variables that are associated but obviously not causal. An example may entail having students plot their arm length and height. Though the two variables will be associated, having a large arm length does not cause you to be tall. And using a stretching regimen designed to increase your arm length will likely have no impact on your height.

Instructional Resources

Mathematics Formative Assessments (MFAS)	Additional Lesson Resources
Sleep and Reading Students are asked to interpret a correlation coefficient in context and describe a possible causal relationship. Does Studying Pay? Students are given a scenario describing an association between two variables and are asked to determine if one variable is a cause of the other. Listing All Possible Causal Relationships Students are asked to identify all possible causal relationships between two correlated variables. Illustrative Mathematics Assessment Tasks Coffee and Crime This problem solving task asks students to examine the relationship between shops and crimes by using a correlation coefficient. Golf and Divorce This is a simple task addressing the distinction between correlation and causation. Students are given information indicating a correlation between two variables, and are asked to reason out whether or not a causation can be inferred.	

Algebra 1 Honors	**Unit 3: Use properties of rational and irrational numbers.**	2 days: 1/8-1/9

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.912.N-RN.2.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.	• Expressions should contain no more than three variables. Calculator: **NO** • Editing Task • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)

- Chapter 10: Radical Functions and Geometry
  - Algebra Lab: Rational and Irrational Numbers

Algebra Nation

- Operations with Rational and Irrational Numbers

EngageNY Instructional Resource (may not cover all content required for the aligned standards)

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Decoded Standard

MAFS.912.N-RN.2.3
Students work with symbolic forms of rational and irrational numbers to make conjectures about closure for addition and multiplication and to be able to explain why their conjectures work. The key word is *explain*. It is not sufficient for students to apply an algorithm to complete a calculation; they must understand what that calculation means. (*Common Core Mathematics Companion*, Pg. 18)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources
Sum of Rational and Irrational Numbers Students are asked to describe the difference between rational and irrational numbers and then explain why the sum of a rational and an irrational number is irrational. Product of Rational Numbers Students are asked to define a rational number and then explain why the product of two rational numbers is rational. Sum of Rational Numbers Students are asked to define a rational number and then explain why the sum of two rational numbers is rational. Product of Non-Rational Zero Numbers Students are asked to describe the difference between rational and irrational numbers, and then explain why the product of a non-zero rational and an irrational number is irrational. Illustrative Mathematics Assessment Tasks Calculating the Square root of 2 This task is intended for instructional purposes so that students can become familiar and confident	

with using a calculator and understanding what it can and cannot do. Operations with Rational and Irrational Numbers This task has students experiment with the operations of addition and multiplication, as they relate to the notions of rationality and irrationality.	

Algebra 1 Honors	Unit 4: Extend the properties of exponents to rational exponents.	3 days: 1/10-1/14

Standards/Learning Goals:	Content Limits, Assessment Types, Calculator
MAFS.912.N-RN.1.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*	• Expressions should contain no more than three variables. Calculator: **NO** • Editing Task • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response
MAFS.912.N-RN.1.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.	• Expressions should contain no more than three variables. • For N-RN.1.2, items should not require the student to do more than two operations Calculator: **NO** • Editing Task • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)

- Chapter 7: Exponents and Exponential Functions
  - Lesson 1: Multiplication Properties of Exponents *(not part of either standard, but probably needed)*
  - Lesson 2: Division Properties of Exponents *(not part of either standard, but probably needed)*
  - Lesson 3: Rational Exponents

Algebra Nation

- Properties of Exponents
- Radical Expressions and Expressions with Rational Exponents
- Adding Expressions with Radicals and Rational Exponents
- More Operations with Radical and Rational Exponents

EngageNY Instructional Resource (may not cover all content required for the aligned standards)

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Decoded Standard

MAFS.912.N-RN.1.1

Students use the exponent property $(a^b)^c = a^{bc}$ from earlier grades to derive the meaning of rational exponents. The connection between inverse operations (such as multiplication undoes division) is expanded to radicals and exponents. For example, $(\sqrt{25})^2 = 5^2 = 25$ is a good starting point for considering how a square root and squaring undo each other. Exploring similar problems by hand and with technology resources leads students to discover what exponents must stand for a given radical (that $\frac{1}{2}$ is the exponent that means the same thing as $\sqrt{}$).

Problems such as $\left(\sqrt{25}\right)^3 = 5^{\frac{3}{2}} = \left(5^{\frac{1}{2}}\right)^3 = 5^3 = 125$ further extend the meaning of fractional exponents beyond fractions with a numerator of one. Students must also connect the meaning of functions with the restricted range of operations such as the square root – that is, students must be able to explain that $\sqrt{9} = 3$ and not $\sqrt{9} = \pm 3$ in order to satisfy the demand that a square root be a function. (*Common Core Mathematics Companion*, Pg. 14)

Instructional Resources

Illustrative Mathematics Assessment Tasks	Lesson Resources
Evaluating a Special Exponential Expression Three students disagree about what value to assign to the expression 00. In each case, critically analyze the student's argument. Evaluating Exponential Expressions This task is to use properties of exponents for whole numbers in order to explain how expressions with fractional exponents are defined. Checking a Calculation of a Decimal Exponent This task is to connect properties of fractional exponents with ordering of real numbers. Extending the Definitions of Exponents, Variation 2 Students will develop an understanding of why rational exponents are defined as they are.	• MARS/Shell ○ Manipulating Radicals Students will use the properties of exponents, including rational exponents and manipulate algebraic statements involving radicals. Discriminate between equations and identities.

Decoded Standard

MAFS.912.N-RN.1.2

Students are able to use both radical and exponential forms to write expressions and can translate flexibility between them. Students use symbolic examples, such as $a^2\sqrt{a} = a^2 \cdot a^{\frac{1}{2}} = a^{\frac{5}{2}}$, and contextual examples, like solving $V = \frac{4}{3}\pi r^3$ for *r*.

Instructional Resources

Illustrative Mathematics Assessment Tasks	Lesson Resources

Algebra 1 Honors	**Unit 5: Understand the concept of a function and use function notation. Interpret functions that arise in applications in terms of the context.**	5 days: 1/15-1/22

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.912.F-IF.1.1 (Assessed under F-IF.1.2) Understand that a function from one set (called a domain) to another set (called the range assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f(x),* denotes the output of *f* corresponding to the input *x*. The graph of, *f* is the graph of the equation *y=f(x).*	• Items that require the student to determine the domain using equations within a context are limited to exponential functions with one translation, linear functions, or quadratic functions. • Items may present relations in a variety of formats, including sets of ordered pairs, mapping diagrams, graphs, and input/output models. • In items requiring the student to find the domain from the graphs, relationships may be on a closed or open interval. • In items requiring the student to find the domain from graphs, relationships may be discontinuous. • Items may not require students to know or use interval notation Calculator: **NEUTRAL** • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.912.F-IF.1.2 (Also assesses F-IF.1.1 and F-IF.2.5) Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.	• In items that require the student to find a value given a function, the following function types are allowed: quadratic, polynomials whose degrees are no higher than 6, square root, cube root, absolute value, exponential except for base e, and simple rational. Calculator: **Neutral** • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.912.F-IF.1.3 Recognize that sequences are functions, sometimes defined recursively whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by f(0)=f(1)-1, f(n+1)=f(n)+f(n-1) for $n \geq 1$	• In items where the student constructs an exponential function, a geometric sequence in a recursive definition from input-output pairs, at least two sets of pairs must have consecutive inputs. Calculator: Neutral • Editing Task Choice • Equation Editor • GRID • Hot Text • Multiple Choice • Multi-Select • Open Response • Table Item

MAFS.912.F-IF.2.4 (Also assesses F-IF.3.9) For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetric; and behavior; and periodicity.	• Functions can be linear, quadratic or exponential • Functions can be represented using tables or graphs. Functions represented using these representations are not limited to linear, quadratic or exponential. • Functions may have closed domains • Functions may be discontinuous • Items may not require students to use or know interval notation.
	Calculator: **NO**
	• Equation Editor • GRID • Hot Text • Multiple Choice • Open Response

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)

- Chapter 1: Expressions, Equations, and Functions
  - Lesson 6: Relations
  - Lesson 7: Functions
  - Lesson 8: Interpreting Graphs of Functions

Algebra Nation

- Input and Output Values
- Representing, Naming, and Evaluating Functions
- Real-World Combinations and Compositions of Functions
- Arithmetic Sequences
- Geometric Sequences
- Comparing Arithmetic and Geometric Sequences
- Exploring non-Arithmetic, non-Geometric Sequences

EngageNY Instructional Resource (may not cover all content required for the aligned standards)

- Algebra 1 Module 3, Topic A, Lesson 1
- Algebra 1 Module 3, Topic A, Lesson 2
- Algebra 1 Module 3, Topic A, Lesson 3
- Algebra 1 Module 3, Topic B, Lesson 8
- Algebra 1 Module 3, Topic B, Lesson 9
- Algebra 1 Module 3, Topic B, Lesson 10
- Algebra 1 Module 3, Topic B, Lesson 11
- Algebra 1 Module 3, Topic B, Lesson 12

Decoded Standard

MAFS.912.F-IF.1.1
Students will understand that a function is a special relationship between two sets (the domain, or the input or dependent values, and the range, or output or independent values) in which each domain value corresponds to one and only one range value. Students can determine if a relation is a function by looking at the sets of pairs of

elements, a rule, a graph, or a table of values. The vertical line test is not referenced in the Standards because it requires students to understand the underlying concept of function and to have the knowledge of when it may not apply (such as functions that are not graphed or some parametrically defined functions). Students understand that the graph of *f* is the same as using *y*= symbols, but that the function notation allows us the flexibility of seeing both the input and output in one statement. Students can then make the connection between the statements "the graph of *f*" and "the graph of *y*=*f*(*x*)". (*Common Core Mathematics Companion*, Pg. 146)

Instructional Resources

Mathematics Formative Assessments (MFAS)

Identifying Functions Students identify functions from tables and maps.

Identifying the Graphs of a Function Students identify graphs as functions or not functions

Writing Functions Students write functions in tables and maps

Cafeteria Function Students are asked to decide if one variable is a function of the other in the context of a real-world problem.

What is a Function? Students are asked to define the term function and describe any important properties of functions.

Additional Lesson Resources

- MARS/Shell A culminating lesson task using a coherent approach to this unit
  - Functions and Everyday Situations This is a lesson that develops depth of understanding of functions through interpretation, identifying and analyzing situations that make up functions.

Decoded Standard

MAFS.912.F-IF.1.2

Students practice with function notation so they acquire fluency with it. Using a context, such as having *d* stand for a distance function relating to miles and time in hours lets students view *d*(5)=105 as the distance traveled at time 5 hours is 105 miles. Students read this as "*d* of 5" and interpret *d*(5) to stand for the output value of the function, whether it is evaluated or not.

Students can use graphing technology to explore expressions for functions such as *g*(*x*)+4 or *h*(*x*-1) to gain facility with function notation. This is especially helpful to build students' understanding that function notation is not an arithmetic operation – that is, does not indicate multiplication or the possibility of the distributive property. (*Common Core Mathematics Companion*, Pg. 148)

Instructional Resources

Mathematics Formative Assessments (MFAS)

What is the Function Notation? Explores what function notation represents for students.

What is the Value? Students evaluate corresponding input values in a function table.

Graphs and Functions Students determine a given function at an input by inspecting its graph.

Illustrative Mathematics Assessment Tasks

The Random Walk This task requires interpreting functions.

Yam in the Oven Students practice interpreting statements using function notation.

The Parking Lot Students investigate the meaning of the definition of a function based on a situation.

Additional Lesson Resources

- MARS/Shell *A culminating lesson task using a coherent approach to this unit*
  - …Functions and Everyday Situations This is a lesson that develops depth of understanding of functions through interpretation, identifying and analyzing situations that make up functions.

Decoded Standard

MAFS.912.F-IF.1.3

Students will understand there can be special types of function notation used for sequences and recursive functions. For a geometric sequence that is defined recursively, students may see $a_n = a_{n-1}r$, where *n* is the index or term number, and a_{n-1} stands for the previous term of the function, as well as more standard notation such as $g(n) = g(n-1)r$. It is helpful to provide examples to help students see sequences as a set of range values with an index from the integers – a first term, second term, third term, and so forth. For example, a sequences can be written as $a_n = n + 1$, so that $a_1 = 2$, $a_2 = 3$, … , $a_6 = 7$, and so on. Tables are frequently used to investigate sequences. (*Common Core Mathematics Companion*, Pg. 150)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources
Recursive Sequences Students are asked to find the first five terms of a sequence recursively, explain why the sequence is a function, and describe its domain. Which Sequences are Functions? Students are asked to determine if each of two sequences is a function and to describe its domain, if it is a function.	

Decoded Standard

MAFS.912.F-IF.2.4

Students attain conceptual understanding of the key features of a function by focusing on graphs and tables of the related quantities. (*Common Core Mathematics Companion*, Pg. 152)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Additional Lesson Resources
Elevation Along a Trail Students interpret key features of a graph (symmetry) in the context of a problem situation. Uphill and Downhill Students interpret key features of a graph (intercepts and intervals over which the graph is increasing) in the context of a problem situation. Taxi Ride Students sketch a graph from a verbal description. Bike Race Students evaluate three verbal descriptions and to state why each does or does not match a given graph. Surf's Up Students are given a table of functional values and asked to describe and interpret key features of the graph in the context of the problem. Illustrative Mathematics Assessment Tasks Snake on a Plane This task has students approach a function via both a recursive and an algebraic definition, in the context of a famous game. Warming and Cooling Straightforward interpretation to read and interpret a graph. Telling a story with graphs Students examine graphs and interpret them giving a verbal description of what they see.	• MARS/Shell *A culminating lesson task using a coherent approach to this unit* ○ …Functions and Everyday Situations This is a lesson that develops depth of understanding of functions through interpretation, identifying and analyzing situations that make up functions.

Algebra 1 Honors	**Unit 6: Interpret the structure of expressions.**	2 days: 1/23-1/24

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.912.A-SSE.1.1 Interpret expressions that represent a quantity in terms of its context. a) Interpret parts of an expression, such as terms, factors, and coefficients. b) Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret as the product of P and a factor not depending on P.	• For A-SSE.1.1, items should not ask the student to interpret zeros, the vertex, or axis of symmetry when the quadratic expression is in the form ax2 + bx + c (see F-IF.3.8). Calculator: **NEUTRAL** • Edit Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)

- Chapter 1: Expressions, Equations, and Functions
  - Lesson 1: Variables and Expressions
  - Lesson 2: Order of Operations (requires complex expressions)
  - Lesson 3: Properties of Numbers

Algebra Nation

- Using Expressions to Represent Real-World Situations
- Understanding Polynomial Expressions
- Algebraic Expressions Using the Distributive Property
- Algebraic Expressions Using the Commutative and Associative Properties.

EngageNY Instructional Resource (may not cover all content required for the aligned standards)

- Algebra 1 Module 1, Topic B, Lesson 6
- Algebra 1 Module 1, Topic B, Lesson 7
- Algebra 1 Module 4, Topic B, Lesson 12
- Algebra 1 Module 4, Topic B, Lesson 16

Decoded Standard

MAFS.912.A-SSE.1.1
Students see that complicated expressions are built up out of simpler ones. Part of this understanding means students know what a factor is, know how factors and coefficients are related, and know how constants, factors, and/or coefficients relate to terms in an expression. Students work with the structure of a complicated expression, identify the parts to help understand what the expression means. Complex formulas in science or other disciplines are a rich source of applications for these standards. The Doppler Effect formula, $f = \left(\frac{c+v_r}{c+v_s}\right) f_0$, can be seen as the product but also as including a part that is quotient in which both the numerator and denominator have a similar format in which the velocity of the waves in a medium, *c*, are affected by the velocity of the receiver or source to the medium. Students can determine the relative values of each and make estimates about the size of the Doppler Effect. Students may also recognize that the computational rules they have learned mean that the expression $\left(\frac{c+v_r}{c+v_s}\right) f_0$ is not equivalent to $\left(\frac{1+v_r}{1+v_s}\right) f_0$. (*Common Core Mathematics Companion*, Pg. 81)

Instructional Resources

Standards are not to be taught in the sequence presented but as a coherent approach through thoughtful lesson planning.
Using the textbook is not always meeting the depths of the new standards that is why other resources are provided

Mathematics Formative Assessments (MFAS)	Additional Lesson Resources
Dot Expressions Students are asked to explain how parts of an algebraic expression relate to the number and type of symbols in a sequence of diagrams. Interpreting Basic Tax Students interpret the parts of an equation used to calculate the total purchase price including tax of a set of items. What Happens? Students are asked to determine how the volume of a cone will change when its dimensions are changed. **Illustrative Mathematics Assessment Tasks** Animal Populations Students interpret the relative size of variable expressions involving two variables in the context of a real world situation. Mixing Fertilizer Students generalize the problem and verify conclusions using algebraic rather than numerical expressions. The Bank Account Students explore an expression that calculates the balance of a bank account with compounding interest. Cubic Identity This task presents a challenging exercise in both algebraic manipulations and seeing structure in algebraic expressions. Seeing Dots The purpose of this task is to identify the structure in the two algebraic expressions by interpreting them in terms of a geometric context.	• MARS/Shell: ○ Sorting Equations and identities Students will be able to: Recognize the differences between equations and identities. Substitute numbers into algebraic statements in order to test their validity in special cases. Resist common errors when manipulating expressions such as $2(x - 3) = 2x - 3$; $(x + 3)^2 = x^2 + 3^2$. Carry out correct algebraic manipulations.

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Algebra 1 Honors	**Unit 7: Create and solve equations and inequalities**	6 days: 1/27-2/3
Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**	
MAFS.912.A-CED.1.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational, absolute, and exponential functions.	• In items that require students to write an equation, equations are limited to linear, quadratic, and exponential. • Items may include equations or inequalities that contain variables on both sides. Calculator: Neutral • Equation Response • Graphic Response • Hot Spot Response • Movable Text Response • Multiple Choice Response • Multi-select Response • Natural Language Response • Selectable Text Response	
MAFS.912.A-CED.1.2 Create equations in two or more variable s to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	• Items that require the student to write a system of equations using a real-world context are limited to a system of 2x2 linear equations with integral coefficients if the equations are written in the form Ax+By=C. • Items that require the student to solve a system of equations are limited to a system of 2x2 linear equations with integral coefficients if the equations are written in the form Ax+By=C. • Items that require the student to graph a system of equations or inequalities to find the solution are limited to a 2x2 system. • Items that require the student to write a system of inequalities using a real-world context are limited to integer coefficients. Calculator: Neutral • Editing Task Choice • Equations Editor • GRID • Hot Text • Multiple Choice • Multiselect • Open Response	
MAFS.912.A-CED.1.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning a in solving equations. For example, rearrange Ohm's law V=IR to highlight resistance R	• Items that involve formulas should not include overused contexts such as Fahrenheit/Celsius or three-dimensional geometry formulas. • In items that require students to solve literal equations and formulas, a linear term should be the term of interest. • Items should not require more than three procedural steps to isolate the variable of interest. • Items may require the student to recognize equivalent expressions but may not require a student to perform an algebraic operation outside the context of Algebra 1. Calculator: Neutral • Drag and drop response • Equation Response • Hot Spot Response • Multiple Choice Response • Natural Language Response	

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MAFS.912.A-REI.1.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.	• Items will not require students to recall names of properties from memory Calculator: No • Drag and drop response • Equation Response • Movable Text Response • Multiple Choice Response • Natural Language Response • Selectable Text Response
MAFS.912.A-REI.1.2 **(Algebra 2 standard not tested)** Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	• Calculator: •
MAFS.912.A-REI.2.3 **(Assessed with MAFS.912.A-CED.1.1)** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	• In items that require students to write an equation, equations are limited to linear, quadratic, and exponential. • Items may include equations or inequalities that contain variables on both sides. Calculator: Neutral • Equation Response • Graphic Response • Hot Spot Response • Movable Text Response • Multiple Choice Response • Multi-select Response • Natural Language Response • Selectable Text Response

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)

- Chapter 2: Linear Equations
  - Lesson 4: Solving Equations with Variables on Each side
  - Lesson 5: Solving Equations Involving Absolute Value
  - Lesson 6: Ratios and Proportions
  - Lesson 8: Literal Equations and Dimensional Analysis
- Chapter 5: Linear Inequalities
  - Algebra Lab: Reading Compound Statements
  - Lesson 4: Solving Compound Inequalities
  - Lesson 5: Inequalities Involving Absolute Value
- Chapter 10
  - Lesson 2: Simplifying Radical Expressions
  - Algebra Lab: Rational and Irrational Numbers
  - Lesson 3: Operations with Radical Expressions
  - Lesson 4: Radical Equations
- Chapter 11
  - Lesson 2: Rational Functions
  - Lesson 3: Simplifying Rational Expressions
  - Lesson 4: Multiplying and Dividing Rational Expressions

Algebra Nation

- Equations: True or False?
- Identifying Properties When Solving Equations.
- Solving Equations

Standards are not to be taught in the sequence presented but as a coherent approach through thoughtful lesson planning.
Using the textbook is not always meeting the depths of the new standards that is why other resources are provided

- Solving Equations Using the Zero Product Property
- Solving Inequalities – Part 1
- Solving Inequalities – Part 2
- Solving Compound Inequalities
- Rearranging Formulas
- Solution Sets to Inequalities with Two Variables *(also part of Unit 8)*

EngageNY Instructional Resource (may not cover all content required for the aligned standards)

- Algebra 1 Module 1, Topic C, Lesson 10
- Algebra 1 Module 1, Topic C, Lesson 11
- Algebra 1 Module 1, Topic C, Lesson 12
- Algebra 1 Module 1, Topic C, Lesson 13
- Algebra 1 Module 1, Topic C, Lesson 14
- Algebra 1 Module 1, Topic C, Lesson 15
- Algebra 1 Module 1, Topic C, Lesson 16
- Algebra 1 Module 1, Topic C, Lesson 17
- Algebra 1 Module 1, Topic C, Lesson 18
- Algebra 1 Module 1, Topic C, Lesson 19
- Algebra 1 Module 1, Topic C, Lesson 20
- Algebra 1 Module 1, Topic C, Lesson 21
- Algebra 1 Module 1, Topic D, Lesson 25
- Algebra 1 Module 1, Topic D, Lesson 28

Decoded Standard

MAFS.912.A-CED.1.1
Students look for patterns in one variable in data, contextual situations, and other numeric patterns and create equations or inequalities for them. Then, the equations or inequalities are used to solve contextual problems. The equations can arise from many situations, depending on the material the students have studied, including linear (started in younger grades), quadratics, exponentials, and rational situations.
(*Common Core Mathematics Companion*, Pg. 107)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Additional Lesson Resources

State Fair Students will model a real world equation based on a scenario and they will solve to find the cost of tickets
Music Club In this exercise students will create an inequality in one variable that models a real world situation
Quilts Students are asked to write and solve an equation that models a given problem.
Follow Me Students are asked to write and solve an equation that models an exponential relationship between two variables
 	
Illustrative Mathematics Assessment Tasks
Planes and wheat identifying the correct value and substituting the value in for the variable to create equations.
Paying the Rent Students solve problems tracking the balance of a checking account
Basketball Students set up rational equations in a real world context
	• Algebra Nation
	  ○ Solving Equations
	  ○ Solving Equations Using the Zero Product Property

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Using the textbook is not always meeting the depths of the new standards that is why other resources are provided

Decoded Standard	
MAFS.912.A-CED.1.2 Students look for patterns in bivariate (two-variable matched) data, contextual situations, and other numeric patters and create equations or inequalities for them. The equations, inequalities, or systems of equations or inequalities are used to solve contextual problems. (*Common Core Mathematics Companion*, Pg. 109)	
Instructional Resources	
Mathematics Formative Assessments (MFAS)	Additional Lesson Resources

Hotel Swimming Pool Students are asked to write an equation in two variables given a verbal description of the relationship among the variables.
Loss of Fir Trees Students are asked to sketch a graph that depicts the exponential decline in the population of fir trees in a forest.
Model Rocket Students are asked to graph a function in two variables given in context.
Tech Repairs Students are asked to write an equation in two variables from a verbal description.
Tech Repairs Graph Students are asked to graph an equation in two variables given in context.
Tee It Up Students are asked to write an equation in three variables from a verbal description.
Trees in Trouble Students are asked to write a function that represents an annual loss of 3% per year.
	• Algebra Nation
	  ○ Rearranging Formulas
	  ○ Solution Sets to Equations with Two Variables

Decoded Standard	
MAFS.912.A-CED.1.4 Students solve literal equations for a variable of interest. The process of solving should be closely related to solving equations for unknown numerical quantities. (*Common Core Mathematics Companion*, Pg. 111)	
Instructional Resources	
Mathematics Formative Assessments (MFAS)	Additioanl Lesson Resources
Solving Formulas for a Variable Students are asked to solve for a specific variable from the slope equation and slope intercept equation. Solving Literal Equations Students are given 3 variable problems and asked to solve for a specific variable. Literal Equations Students are given three variable equations and asked to solve using inverse of multiplication and division Rewriting Equations Students are asked to solve a four variable equation.	• Algebra Nation ○ Rearranging Formulas

Decoded Standard
MAFS.912.A-REI.1.1 Students explain the steps for solving an equation. In addition, students apply SMP 3 by constructing viable rationales for their solution processes. Students who simply memorize steps to solve an equation without justifying their reasoning will fall short of what this standard is asking. Students need to use the basic principle of equivalency in equations to create methods for solving equations that make mathematical sense. These solution methods may be an alternative to traditional methods, such as "performing the order of operations in reverse order" for an equation such as $\sqrt{3x+1}=4$; we first square to undo the square root to get 16, then we subtract the 1 to get 15, and finally we divide by 3 to get 5. (*Common Core Mathematics Companion*, Pg. 116)

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Instructional Resources	

Mathematics Formative Assessments (MFAS)
Justify the Process 1 Students are asked to justify each step in the process of solving equations.
Justify the Process 2 Students are asked to justify each step in the process of solving equations.
Equation Logic Students are given linear equations and asked to justify each step in the process of solving.
Does it Follow? Students are asked to compare two equations and determine if they are equivalent
Illustrative Mathematics Assessment Tasks
1-2 Same Solutions? Students reason about equivalence of equations
How Does the Solution Change? Students reason about their solutions.
	Additional Lesson Resources
	• Algebra Nation
	  ○ Identifying Properties When Solving Equations
	  ○ Solving Equations

Decoded Standard
MAFS.912.A-REI.1.2 *(Algebra 2 Standard)* This standard builds on the framework provided in standard A-REI.1.1 and the concept of retaining equivalency when performing the same operation to both sides of an equation. In particular, this standard focuses on solving equations in which unknown values may be in the denominator or beneath a radical, causing restrictions in the possible solutions for an equation. Solutions that are found when performing the same operation to both sides of an equation may be erroneous (called extraneous roots) based on mathematical definitions of dividing by zero or the principle square root. For example, the two equations below have both valid and extraneous solutions: See examples on Pg. 118 (*Common Core Mathematics Companion*, Pg. 118)

Instructional Resources	
Mathematics Formative Assessments (MFAS)	Lesson Resources ○

Decoded Standard
MAFS.912.A-REI.2.3 Students solve linear equations and inequalities with one variable. Students use methods such as manipulatives, tables, graphs, technology such as graphing calculators or spreadsheets, and symbols. The problems explored include undoing an operation, using the distributive property, and solving literal equations, such as $Ax + By = C$, solved for *y*. (*Common Core Mathematics Companion*, Pg. 121)

Instructional Resources	

Mathematics Formative Assessments (MFAS)
Solve for M Students are asked to solve a linear equation in one variable.
Solve for N Students are asked to solve a linear equation in one variable with fractional coefficients.
Solve for X Students are asked to solve a linear equation in one variable.
Solve for Y Students are asked to solve a linear inequality in one variable.
Solving a Literal Linear Equation Students are given a literal linear equation and asked to solve for a specific variable.
Solving a Multistep Inequality Students are asked to solve a multistep inequality.
	Additional Lesson Resources
	• Algebra Nation
	  ○ Equations: True or False?
	  ○ Identifying Properties When Solving Equations
	  ○ Solving Equations
	  ○ Solving Inequalities – Part 1
	  ○ Solving Inequalities – Part 2
	  ○ Solving Compound Inequalities
	  ○ Rearranging Formulas

ALGEBRA 1 HONORS	**Unit 8: Represent and solve equations and inequalities graphically.**	6 days: 2/4-2/11

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.912.A-CED.1.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.	• In items that require the student to write an equation as a constraint, the equation can be a linear function. • In items that require the student to write a system of equations to represent a constraint, the system is limited to a 2x2 with integral coefficients Calculator: **Neutral** • Equation Response • Graphic Response • Hot Spot Response • Movable Text Response • Multiple Choice Response • Natural Language Response • Selectable Text Response
MAFS.912.A-REI.4.10 **(Assessed under REI.4.11)** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).	• In items where a function is represented by an equation, the function may be an exponential function with no more than one translation, a linear function, or a quadratic function. • In items where a function is represented by a graph or table, the function may be any continuous function. Calculator: **NEUTRAL** • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.912.A-REI.4.11 Explain why the x-coordinates of the points where the graphs of the equations y=f(x) and y=g(x) intersect are the solutions of the equations f(x)=g(x), find the solutions approximately, e.g. Using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and /or g(x) are linear, polynomial, rational, absolute value,-exponential, and logarithmic.	• In items where a function is represented by a graph or table, the function may be any continuous function. Calculator: Neutral • Equation Editor • GRID • Hot Text • Multiple Item • Multiple Choice • Multi-Select • Open Response • Table Item
MAFS.912.A-REI.4.12 Graph the solution to a linear inequality in two variables as a half-plane(excluding the boundary in the case of a strict inequality), ~~and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes~~.	• Items that require the student to graph a system of equations or inequalities to find the solution are limited to a 2x2 system. • Items that require the student to write a system of inequalities using a real world context are limited to integral coefficients. Calculator: **Neutral** • Editing Task Choice • Equation Editor • GRID • Hot Text • Multiple Choice • Multi-Select • Open Response

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McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)

• Chapter 3: Linear Functions
  ○ Lesson 1: Graphing Linear Equations
  ○ Lesson 2: Solving Linear Equations
  ○ Algebra Lab: Rate of Change of a Linear Function
  ○ Lesson 3: Rate of Change and Slope
  ○ Lesson 4: Direct Variation
• Chapter 4: Equations of Linear Functions
  ○ Lesson 1: Graphing Equations in Slope-Intercept Form
  ○ Lesson 2: Writing Equations in Slope-Intercept Form
  ○ Lesson 3: Writing Equations in Point-Slope Form
  ○ Lesson 4: Parallel and Perpendicular Lines
• Chapter 5: Linear Inequalities
  ○ Lesson 6: Graphing Inequalities in Two Variables

Algebra Nation
• Key Features of Graphs of Functions – Part 1 • Key Features of Graphs of Functions – Part 2 • Modeling with Functions • Solution Sets to Equations with Two Variables • Solution Sets to Inequalities with Two Variables *(also part of Unit 7)* • Understanding Piecewise-Defined Functions • Absolute Value Functions • Graphing Power Functions – Part 1 • Graphing Power Functions – Part 2

EngageNY Instructional Resource (may not cover all content required for the aligned standards)
• Algebra 1 Module 1, Topic A, Lesson 2 • Algebra 1 Module 1, Topic A, Lesson 3 • Algebra 1 Module 1, Topic A, Lesson 4 • Algebra 1 Module 1, Topic A, Lesson 5

Decoded Standard
MAFS.912.A-CED.1.3 Students consider an equation in terms of what makes sense for its solution within a given context. If a student is trying to make an equation to find the lengths of the sides for a box with a volume of 20 cubic inches and made by cutting squares from the corners of a piece of cardboard that is 6 inches by 10 inches, he or she may create an equation $x(6-2x)(10-2x)=20$ for the volume. The student needs to understand that the largest side of any square cut from the cardboard can be is 3 inches and why that is the case. The student also needs to recognize that *x* cannot be less than or equal to 0. The student represents constraints for the equation using the inequality, $0<x<3$. The student may use a graph to see that there are 3 values for *x* that satisfy the equation; however, one solution will be greater than 3 and so must be excluded. When students find solutions to equations or inequalities, they need to check the solutions to ensure they make sense in the context of the problem. If students find the average number of students that can be put on each of three buses for a field trip is $33\frac{1}{3}$ students, they need to see it is not a viable answer, since the number of

students must be a whole number, and then determine how to handle that discrepancy. Students should have opportunities to contextually, analytically, and graphically check a solution set of inequalities to determine the viability of a solution. (*Common Core Mathematics Companion*, Pg. 110)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Additional Lesson Resources
Sugar and Protein Students are asked to model a problem involving constraints using inequalities. The New School Students are asked to recognize constraints in a real world context. Constraints on Equations Students are asked to analyze constraints on equations in context and interpret the solutions as viable or not viable. Illustrative Mathematics Assessment Tasks Fishing Adventures 3: Students write and solve inequalities, and represent the solutions graphically.	

Decoded Standard

MAFS.912.A-REI.4.10

Students look at two variables in terms of their covariation. Students may make tables or create sets of ordered pairs that are true for a given equation. Then, students graph their ordered pairs and consider if the set of points represents all possible solutions for the two-variable equation. Students are thus connecting to their understanding of domain and range, as well as to the concepts of discrete and continuous functions. The concept of covariation follows from the middle grades, using the idea that one variable is conditioned on another. Teachers use scaffolding questions such as, "If *x* were a given number, could you determine the corresponding value for *y*? What if *x* takes another value? How could you organize these results?"
(*Common Core Mathematics Companion*, Pg. 134)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Additional Lesson Resources
What is the Point Students are asked to explain the relationship between a point on the graph and a point not on the graph. Finding Solutions Students are asked to explain the relationship between a given linear equation and both a point on its graph and a point not on its graph Case In Point – (explain the relationship between the set of solutions and the graph of an exponential equation, 3 problems) Illustrative Mathematics Assessment Tasks Taxi Students are asked to justify given solutions as reasonable for the situation. Collinear points—4 part task that ask students to conceptually think about nonlinear functions	

Decoded Standard

MAFS.912.A-REI.4.11

In this standard, the focus is on students recognizing what the solution $y = f(x)$ and $y = g(x)$ means on a graph. The equation, $f(x) = g(x)$, is converted into $y = f(x)$ and $y = g(x)$. Now a solution to the original equation is the *x*-coordinate for the new set of equations, $y = f(x)$ and $y = g(x)$. That is, if the original equations are equal at the value of *x*, then (*x*,*y*) is a solution of $y = f(x)$ and $y = g(x)$. In the previous standards, students built a

foundational understanding that the graph of an equation is the set of all points that make the equation true. Now, students consider what that standard means when they look for the solution of $y = f(x)$ and $y = g(x)$ – that is, they are looking for every point that is on both graphs. Using graphs and tables, students can see where common values of $f(x)$ and $g(x)$ occur. When students consider the ordered pairs, they can see the *x*-coordinates are the same, as are the *y*-coordinates that are also named $f(x)$ and $g(x)$. When using tables or some forms of graphs for functions, students may identify approximate solutions by noting when the *x*-values are very close to each other, and the *y*-values ae similar as well. Students can make a smaller interval near such values and use a smaller increment when evaluating different *x*-values to find a closer approximation.
(*Common Core Mathematics Companion*, Pg. 135)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources
Graphs and Solutions: Students are given a graph and asked to explain why the x-coordinate of the intersection of two functions , f and g, is a solution of the equation f(x) = g(x). f(x) is linear and g(x) is cubic. Graphs and Solutions 2: Students are asked to find the solution(s) of the equation f(x) = g(x) given the graphs of f and g and explain their reasoning. F(x) is linear and g(x) is a parabola. Using Tables: Students are asked to find solutions of the equation f(x) = g(x) for two given functions, f and g, by constructing a table of values. Using Technology: Students are asked to use technology (e.g., spreadsheet, graphing calculator, or dynamic geometry software) to estimate the solutions of the equation f(x) = g(x) for given functions f and g. f(x) is linear and g(x) is exponential.	

Decoded Standard

MAFS.912.A-REI.4.12
Students compare the graphs of linear inequalities to those of linear equations. For an inequality such as $y > x + 1$, students explore to see which points make this a true statement, resulting in a half-plane – the values that are bordered by but not including $y = x + 1$ and the ordered pairs that make the statement $y > x + 1$ true. ~~Students find solutions of systems of inequalities are not just points of intersection of the lines but are instead regions of the coordinate plane. When students graph a single linear inequality on the coordinate plane, it creates a boundary (which may or may not be included as part of the solution) and a half-plane. The solution sets that make all of the inequalities in a set of inequalities are actually where the half-planes of the inequalities overlap – that is, the intersection of the corresponding half-planes.~~ (*Common Core Mathematics Companion*, Pg. 137)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Additional Lesson Resources
	• MARS/Shell ○ Defining Regions Using Inequalities: students are able to use linear inequalities to create a set of solutions. Assist students who have difficulties in representing a constraint by shading the correct side of the inequality line and understanding how combining inequalities affects a solution space.

DOUBLE BLOCK

Algebra 1 Honors	**Unit 9: Solve systems of equations and inequalities.**	4 days: 2/12-2/18

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.912.A-REI.3.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.	• Items that require the student to write as system of equation using a real-world context are limited to a system of 2x2 linear equations with integral coefficients if the equations are written in the form *Ax+By=C.* • Items that require the student to solve a system of equations are limited to a system of 2x2 linear equations with integral coefficients if the equations are written in the form *Ax+By=C.* Calculator: Neutral • Editing Task Choice • Equation Editor • GRID • Hot Text • Multiple Choice • Multi-Select • Open Response
MAFS.912.A-REI.3.6 Solve systems of linear equations exactly and approximately (e.g. with graphs), focusing on pairs of linear equations in two variables	• Items that require the student to write as system of equation using a real-world context are limited to a system of 2x2 linear equations with integral coefficients if the equations are written in the form *Ax+By=C.* • Items that require the student to solve a system of equations are limited to a system of 2x2 linear equations with integral coefficients if the equations are written in the form *Ax+By=C.* Calculator: Neutral • Editing Task Choice • Equation Editor • GRID • Hot Text • Multiple Choice • Multi-Select • Open Response
MAFS.912.A-REI.4.12 Graph the solution to a linear inequality in two variables as a half-plane(excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.	• Items that require the student to graph a system of equations or inequalities to find the solution are limited to a 2x2 system. • Items that require the student to write a system of inequalities using a real world context are limited to integral coefficients. Calculator: **Neutral** • Editing Task Choice • Equation Editor • GRID • Hot Text • Multiple Choice • Multi-Select • Open Response

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)

- Chapter 6: Systems of Linear Equations and Inequalities
  - Lesson 1: Graphing Systems of Equations (Review – 8th Grade Standard)
  - Lesson 2: Substitution (Review – 8th Grade Standard)
  - Lesson 3: Elimination Using Addition and Subtraction
  - Lesson 4: Elimination Using Multiplication
  - Lesson 5: Applying Systems of Linear Equations

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Using the textbook is not always meeting the depths of the new standards that is why other resources are provided

- Algebra Lab: Using Matrices to Solve Systems of Equations (Extends beyond Algebra 1 Honors)
- Lesson 6: Systems of Inequalities

Algebra Nation

- Introduction to Systems of Equations
- Finding Solution Sets to Systems of Equations Using Substitution and Graphing
- Using Equivalent Systems of Equations
- Finding Solution Sets to Systems of Equations Using Elimination
- Finding Solution Sets to Systems of Linear Inequalities

EngageNY Instructional Resource (may not cover all content required for the aligned standards)

- Algebra 1 Module 1, Topic C, Lesson 22
- Algebra 1 Module 1, Topic C, Lesson 23
- Algebra 1 Module 1, Topic C, Lesson 24

Decoded Standard

MAFS.912.A-REI.3.5
The purpose of this standard is for students to justify the addition of two equations to determine solutions in a system of equations and justify their method for solving systems of equations. Though these concepts may appear to be unintuitive, students may develop these ideas naturally using specific problem tasks.
(*Common Core Mathematics Companion*, Pg. 127)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Additional Lesson Resources
Solution Sets of Systems Students are asked to show that, given a system of two equations in two variables, replacing one equation with the sum of that equation and a multiple of another produces a system with the same solutions. Solving Systems Students are given a system of two linear equations and asked to form a new system by replacing one equation with the sum of that equation and a multiple of the other. Then students are asked to explain why the two systems have the same solutions.	

Decoded Standard

MAFS.912.A-REI.3-6
Students solve systems of linear equations approximately by observing the intersection of two linear graphs, created either by hand or using technology. Students understand the intersection point will satisfy both equations and is the solution to the system of equations. To solve systems of equations exactly, students may use elimination or substitution. In addition to systems of equations being modeled algebraically, students may represent situations using tape diagrams and algebra tiles. Solution methods should related to and be developed from A-REI.3.5 and A-REI.1.1. (*Common Core Mathematics Companion*, Pg. 128)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Additional Lesson Resources
Apples and Peaches: Asked to solve a system of equations with rational solutions either algebraically or by graphing and are asked to justify the choice of method. Solving a System of Equations 1: Students are asked to solve a system of equations both algebraically and graphically. One equation is in slope intercept form.	• MARS/Shell ○ Optimizing Problems: Boomerangs – Students will develop a system of equations from a linear application. ○ Solving Linear Equations in Two Variables: This lesson unit is intended to help you assess how well students are able to formulate and solve problems using

Solving a System of Equations 2: Students are asked to solve a system of equations both algebraically and graphically. Both equations will have to be re-arranged by the student. Solving a System of Equations 3: Students are asked to solve a system of equations both algebraically and graphically. One equation is in slope intercept form. Illustrative Mathematics Assessment Tasks Cash Box: This task involves the creation and solving of a system of two equations and two unknowns. A dollar is outside the cash box, the task is to decide if the dollar should go inside the box based on ticket prices. Application of Linear Systems Accurately Weighing Pennies 1: This problem involves solving a system of algebraic equations from a context: depending how the problem is interpreted, there may be one equation or two. Application of Linear Systems, this is a three part problem. Quinoa Pasta 2: Students are given all the relevant information on the nutritional labels of quinoa, but they have to figure out how to use this information. They have to come up with the idea that they can set up two equations in two unknowns to solve the problem. Pairs of Whole Numbers: Students will solve systems of linear equations exactly, and provide a simple example of a system with three equations and three unknown. Application problem using three equations. Find a System: The purpose of this task is to encourage students to think critically about both the algebraic and graphical interpretation of systems of linear equations. They are expected to take what they know about systems and reverse the process. Estimating a Solution via Graphs: The purpose of this task is to examine, via graphing, whether or not a solution to a system of two equations is accurate or not. The equations have been chosen so that finding the exact solution requires significant calculations so that it is easy to make an error.	algebra and, in particular, to identify and help students who have the following difficulties with systems of equations.

Decoded Standard
MAFS.912.A-REI.4.12 Students compare the graphs of linear inequalities to those of linear equations. For an inequality such as $y > x + 1$, students explore to see which points make this a true statement, resulting in a half-plane – the values that are bordered by but not including $y = x + 1$ and the ordered pairs that make the statement $y > x + 1$ true. Students find solutions of systems of inequalities are not just points of intersection of the lines but are instead regions of the coordinate plane. When students graph a single linear inequality on the coordinate plane, it creates a boundary (which may or may not be included as part of the solution) and a half-plane. The solution sets that make all of the inequalities in a set of inequalities are actually where the half-planes of the inequalities overlap – that is, the intersection of the corresponding half-planes. (*Common Core Mathematics Companion*, Pg. 137)

Instructional Resources	
Mathematics Formative Assessments (MFAS) Which Graph: Students are asked to select the correct graph of the solution region of a given system of two linear inequalities. Graph a System of Inequalities: Students are asked to graph a system of two linear inequalities.	Additional Lesson Resources • MARS/Shell ○ Defining Regions Using Inequalities: students are able to use linear inequalities to create a set of solutions. Assist students who have difficulties in representing a constraint by shading the correct side of the

	inequality line and understanding how combining inequalities affects a solution space.

Algebra 1 Honors	**Unit 10: Perform arithmetic operations on polynomials.**	6 days: 2/19-2/26

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.912.A-APR.1.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.	• Items set in a real-world context should not result in a non-real answer if the polynomial is used to solve for the unknown. • In items that require addition and subtraction, polynomials are limited to monomials, binomials, and trinomials. The simplified polynomial should contain no more than six terms. • Items requiring multiplication of polynomials are limited to a product of: two monomials, a monomial and a binomial, a monomial and a trinomial, two binomials, and a binomial and a trinomial.
	Calculator: **NO**
	• Edit Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)

- Chapter 8: Quadratic Expressions and Equations
  - Lesson 1: Adding and Subtracting Polynomials
  - Lesson 2: Multiplying a Polynomial by a Monomial
  - Lesson 3: Multiplying Polynomials
  - Lesson 4: Special Products

Algebra Nation

- Adding and Subtracting Functions
- Multiplying Functions
- Closure Property

EngageNY Instructional Resource (may not cover all content required for the aligned standards)

- Algebra 1 Module 1, Topic B, Lesson 8
- Algebra 1 Module 2, Topic B, Lesson 9
- Algebra 1 Module 4, Topic A, Lesson 1

Decoded Standard

MAFS.912.A-APR.1.1
Students perform the operations of addition, subtraction, and multiplication with polynomials. During their work, students realize the results are always polynomials – that is, that polynomials are closed for adding, subtracting, and multiplying. Students gain fluency in their calculations with the arithmetic of polynomials.
(*Common Core Mathematics Companion*, Pg. 91)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources
Adding Polynomials Students find the sum of two polynomials and	

explain if the sum of polynomials always results in a polynomial. Subtracting Polynomials Students find the difference of two polynomials and explain if the difference of polynomials will always result in a polynomial. Multiplying Polynomials 1 Students multiply polynomials and explain if the product of polynomials always results in a polynomial. Multiplying Polynomials 2 Students multiply polynomials and explain if the product of two polynomials always results in a polynomial.	

Pinellas County Schools

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2019-2020

Algebra 1 Honors	**Unit 11: Polynomial relationships and identities.**	7 days: 2/27-3/6

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.912.A-APR.2.2 (Algebra 2 standard not tested) Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x).	• The polynomial that is the dividend should have a degree no less than 3 and no greater than 6. • The polynomial that is the divisor should have a degree of 1, 2, or 3. Calculator: **NO** • Equation Editor • Hot Text • Multiple Choice • Multiselect • Open Response
MAFS.912.A-APR.2.3 Identify zeros of polynomials when suitable factorizations are available and use the zeros to construct a rough graph of the function defined by the polynomial.	• Students will find the zeros of a polynomial function when the polynomial is in factored form. • Students will create a rough graph of a polynomial function in factored form by examining the zeros of the function. • Students will use the x-intercepts of a polynomial function and end behavior to graph the function. Calculator: **NEUTRAL** • Edit Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response
MAFS.912.A-APR.3.4 (Algebra 2 standard not tested) Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.	• Calculator: •
MAFS.912.A-APR.4.6 (Algebra 2 standard not tested) Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.	• Calculator: •
MAFS.912.A-SSE.1.2 Use the structure of an expression to identify ways to rewrite it. For example, see x4 – y 4 as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.	• Calculator: **NEUTRAL** • Edit Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)
• Chapter 8: Quadratic Expressions and Equations ○ Lesson 5: Using the Distributive Property ○ Lesson 6: Solving $x^2 + bx + c = 0$ (extend to include finding the Zeros once factored : A-APR.2.3) ○ Lesson 7: Solving $ax^2 + bx + c = 0$ (extend to include finding the Zeros once factored : A-APR.2.3) ○ Lesson 8 Differences of Squares

Standards are not to be taught in the sequence presented but as a coherent approach through thoughtful lesson planning.

Using the textbook is not always meeting the depths of the new standards that is why other resources are provided

○ Lesson 9 Perfect Square
Algebra Nation
• Real-World Examples of Quadratics • Factoring Quadratic Expressions • Solving Quadratic Equations by Factoring • Solving Other Quadratic Equations by Factoring • Solving Quadratic Equations by Factoring – Special Cases • Solving Quadratic Equations by Raking Square Roots • Solving Quadratic Equations by Completing the Square

EngageNY Instructional Resource (may not cover all content required for the aligned standards)
• Algebra 1 Module 4, Topic A, Lesson 2 • Algebra 1 Module 4, Topic A, Lesson 3 • Algebra 1 Module 4, Topic A, Lesson 4 • Algebra 1 Module 4, Topic A, Lesson 5 • Algebra 1 Module 4, Topic A, Lesson 8 • Algebra 1 Module 4, Topic A, Lesson 9

Decoded Standard	
MAFS.912.A-APR.2.2 *(Algebra 2 Standard)* One specific theorem that students may use when attempting to find zeros or to make a sketch of a polynomial function, $p(x)$, is the Remainder Theorem. The connection to the Zero Factor property and to $p(a)$ being zero when $x - a$ is a factor of $p(x)$ is easily discovered. Comparison of substitutions of $x = a$ into $p(x)$ and then the remainder when dividing $p(x)$ by $x - a$ helps students make the generalization that gives the entire Remainder Theorem. The "if and only if" part of the standard means students need to see that $p(a) = 0$ implies $(x - a)$ is a factor of $p(x)$, and $(x - a)$ is a factor of $p(x)$ implies $p(a) = 0$. (*Common Core Mathematics Companion*, Pg. 93)	
Instructional Resources	
Illustrative Mathematics Assessment Tasks	Lesson Resources
Zeros and Factorizations of Quadratic Polynomials 1 Each of the questions in this task could be formulated as an if and only if statement but the other implication, namely that *f*(*x*) is divisible by *x*-*r* if and only if *r* is a root of *f*. Zeros and Factorizations of Quadratic Polynomials 2 This task continues "Zeroes and factorization of a quadratic polynomial I.'' The argument here generalizes, as shown in "Zeroes and factorization of a general polynomial'' to show that a polynomial of degree d can have at most d roots. The Missing Coefficient The purpose of this task is to emphasize the use of the Remainder Theorem Zeros and Factorizations of general Polynomials In this task, students are asked to show or verify four theorems related to roots, zeroes, and factors of polynomial functions. Zeros and Factorization of a non-polynomial function For a polynomial function f, if f(0)=0 then the polynomial f(x) is divisible by x.	

Decoded Standard
MAFS.912.A-APR.2.3

Students use factoring to rewrite polynomials and then solve for the roots by applying the Zero Factor Property. In combination with identifying multiple roots and substitutions of one or two other *x*-values, students create a rough graph of a given polynomial. One special point of study is the result of a double root (or any other multiple occurrence of a root) on the graph. To better understand this, students apply their learning about the effects of parameter changes on functions (for example, that $y = x^2$ and $y = -x^2$ have different behavior because of the negative coefficient for x^2) about the shapes of specific families of polynomials (at least quadratics and cubics). (*Common Core Mathematics Companion*, Pg. 95)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources
Zeros of a Quadratic Students are asked to identify the zeros of polynomials, without the use of technology, and then describe what the zeros of a polynomial indicate about its graph. Zeros of a Cubic Students are asked to identify the zeros of cubic polynomials, without the use of technology, and then describe what the zeros indicate about the graph. Use Zeros to Graph Students are given the factored form of a cubic polynomial and are asked to use the zeros to sketch the graph between two given points on the coordinate plane without the use of technology	

Decoded Standard

MAFS.912.A-APR.3.4 *(Algebra 2 Standard)*
Students work with identities to verify by examples but then as mathematical proofs. This may be as simple as proving $(x - y)(x + y) = x^2 - y^2$ using an area model or the double distributive property but can include the product of the sum and difference of binomial, the difference of two square terms, the square of a binomial, and so forth. (*Common Core Mathematics Companion*, Pg. 97)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources

Decoded Standard

MAFS.912.A-APR.4.6 *(Algebra 2 Standard)*
Students have experience with division problems when learning about the Remainder Theorem, which they connect to rational expressions as a specific form of a division expression. An expression may be written as a quotient and remainder by using inspections, such as $\frac{x^2+1}{x}$, which is rewritten by inspection as $x + \frac{1}{x}$ or by using long division to obtain the quotient and remainder, such as for $\frac{x^3-x-a}{x-1}$, or for higher degree divisors, such as $\frac{x^3-3x^2+3x-1}{x^2+1}$, by using CAS. (*Common Core Mathematics Companion*, Pg. 101)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources

Decoded Standard

MAFS.912.A-SSE.1.2
Students view expressions from a dynamic perspective – that is, there is progress or change when using expressions flexibly in different formats to find the form that is most useful in a contextual situation. In the standard, students consider $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$ and as the factored form $(x^2 - y^2)(x^2 + y^2)$. This can

help students consider zeros and graphing patterns. Recognizing different forms of an expression and being able to apply the forms is an important step mentioned in the *Progressions for the Common Core State Standards in Mathematics for Algebra* (2013). An example in that document (p. 5) concerns looking at the expression for the sum of a series of perfect squares, $\frac{n(2n+1)(n+1)}{6}$, whose structure allows students to see the expression has a degree of 3 with a leading coefficient of $\frac{1}{3}$, that is the term $\frac{1}{3}n^3$, which is helpful when studying rules for summation notation and integration, providing an underpinning of calculus. Rewriting $y = x^2 + 2x + 1$ as a trinomial square pattern $y = (x + 1)^2$ can help students consider the graph of the function as a translation of $y = x^2$ instead of having to calculate individual ordered pairs to determine the graph.
(*Common Core Mathematics Companion*, Pg. 82)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources
Finding Missing Values Students rewrite quadratic expressions and identify parts of the expressions. Determine the Width Students find the width of a rectangle whose area and length are given as polynomials. Rewriting Numerical Expressions Students are asked to rewrite numerical expressions to find efficient ways to calculate. Illustrative Mathematics Assessment Tasks Equivalent Expressions Students must understand the need to transform the factored form of the quadratic expression (a product of sums) into a sum of products in order to easily see ***a***, the coefficient of the x2 term; *k*, the leading coefficient of the ***x*** term; and *n*, the constant term.	

Algebra 1 Honors	Unit 12: Solve quadratic equations.	6 days: 3/9-3/24

Spring Break is during this Unit: 3/14 – 3/23

Standards/Learning Goals:	Content Limits, Assessment Types, Calculator
MAFS.912.A-SSE.2.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. a. Factor a quadratic expression to reveal the zeros of the function it defines. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. c. Use the properties of exponents to transform expressions for exponential functions. For example, the expression 1.15^t can be rewritten as $\left(1.15^{1/12}\right)^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.	• For A-SSE.2.3, items should require the student to choose how to rewrite the expression. Calculator: **NEUTRAL** • Editing Task • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response
MAFS.912.A-REI.2.4 Solve quadratic equations in one variable. a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x – p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula, and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.	• In items that require the student to transform a quadratic equation to vertex form, the coefficient of the linear term must be an even factor of the coefficient of the quadratic term. • In items that require the student to solve a simple quadratic equation by inspection or by taking square roots, equations should be in the form ax2 = c or ax2 + d = c, where a, c, and d are rational numbers and where c is not an integer that is a perfect square and c –d is not an integer that is a perfect square. In items that allow the student to choose the method for solving a quadratic equation, equations should be in the form ax2 + bx + c = d, where a, b, c, and d are integers. • Items may require the student to recognize that a solution is nonreal but should not require the student to find a nonreal solution. Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response
MAFS.912.A-REI.3.7 **(Algebra 2 standard not tested)** Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y = - 3x and the circle $x^2 + y^2 = 3$.	• Items that require a student to graph a system of equations are limited to a 2 x 2 system. Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Multiple Choice • Multiselect • Open Response

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McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)
• Chapter 9: Quadratic Functions and Equations ○ Lesson 1: Graphing Quadratic Functions ○ Lesson 2: Solving Quadratic Equations by Graphing ○ Lesson 3: Transformations of Quadratic Functions ○ Lesson 4: Solving Quadratic Equations by Completing the Square ○ Algebra Lab: Finding the Maximum or Minimum Value ○ Lesson 5: Solving Quadratic Equations by using the Quadratic Formula ○ Lesson 6: Analyzing Functions with Successive Differences

Algebra Nation
• Deriving the Quadratic Formula • Solving Quadratic Equations Using the Quadratic Formula • Quadratic Functions in Action

EngageNY Instructional Resource (may not cover all content required for the aligned standards)
• Algebra 1 Module 4, Topic A, Lesson 6 • Algebra 1 Module 4, Topic A, Lesson 7 • Algebra 1 Module 4, Topic B, Lesson 11 • Algebra 1 Module 4, Topic B, Lesson 12 • Algebra 1 Module 4, Topic B, Lesson 13 • Algebra 1 Module 4, Topic B, Lesson 14 • Algebra 1 Module 4, Topic B, Lesson 15

Decoded Standard	
MAFS.912.A-SSE.2.3 Students learn several ways to analyze quadratic expressions and their related functions. This standard focuses on factoring and completing the square. Each of these methods has its appropriate place. Students understand that factoring may be an efficient way to analyze a quadratic expression. Completing the square yields another form of a quadratic expression that is sometimes called the vertex or graphing form. This form, $y = a(x-h)^2 + k$, makes it relatively easy to find the vertex of the quadratic function and apply its form to transformations from geometry. Students also apply properties of exponents to create equivalent expressions that can give insight into the quantity described by the exponential expression. (*Common Core Mathematics Companion*, Pg. 84)	
Instructional Resources	
Mathematics Formative Assessments (MFAS) Rocket Town Students are asked to rewrite a quadratic expression in vertex form to find maximum and minimum values. Jumping Dolphin Students are asked to find the zeros of a quadratic function in the context of a modeling problem. Illustrative Mathematics Assessment Tasks Building a General Quadratic Function In this resource, a method of deriving the quadratic formula from a theoretical standpoint is demonstrated. Graphs of Quadratic Functions Students compare graphs of different quadratic functions, then produce equations of their own to satisfy	Lesson Resources • Algebra Nation ○ Solving Quadratic Equations by Factoring ○ Solving Other Quadratic Equations by Factoring ○ Solving Quadratic Equations by Factoring – Special Cases

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given conditions.	

Decoded Standard

MAFS.912.A-REI.2.4
Students build the quadratic formula from a deep understanding of how to solve quadratic equations by completing the square. To do this, students need to be fluent with completing the square when the coefficients of the quadratic are in standard form, $ax^2 + bx + c$, where *a*, *b* and *c* are any real number, $a \neq 0$. In A-SSE.2.3, students were introduced to the concept of completing the square but only to find the maximum or minimum values. One method for doing this is to use an area model while another is using algebra tiles. The following is a sample of completing the square to solve for *x* from an equation in standard form to derive the quadratic formula. The first step is to change the coefficient of x^2 to 1 by dividing all the terms by a.

See the example on page 122

(*Common Core Mathematics Companion*, Pg. 122)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources
Complete the Square-1 Students are asked to solve a quadratic equation by completing the square. Complete the Square-2 Students are asked to solve a quadratic equation by completing the square. Complete the Square-3 Students are asked to solve a quadratic equation by completing the square. Quadratic Formula-1 Students are asked to derive the quadratic formula by completing the square. Complex Solutions? Students are asked to explain how to recognize when the quadratic formula results in complex solutions. Quadratic Formula-2 Students are asked to complete the derivation of the quadratic formula. Which Strategy? Students are shown four quadratic equations and asked to choose the best method for solving each equation.	• Algebra Nation ○ Solving Equations Using the Zero Product Property ○ Solving Quadratic Equations by Factoring ○ Solving Other Quadratic Equations by Factoring ○ Solving Quadratic Equations by Factoring – Special Cases ○ Solving Quadratic Equations by Taking Square Roots ○ Solving Quadratic Equations by Completing the Square ○ Deriving the Quadratic Formula ○ Solving Quadratic Equations Using the Quadratic Formula ○ Quadratic Functions in Action ○ Nature of the Solutions of Quadratic Equations and Functions

Decoded Standard

MAFS.912.A-REI.3.7 (Algebra 2 Standard)
Solving a system consisting of a line and a quadratic is a natural extension from solving a system consisting of two lines. Students realize that while a linear system has the possibility of zero, one, or two solutions, with a system of a linear and a quadratic equation, there is not a possibility of infinite solutions. Students may find the solution set graphically or algebraically. Students connect to analytic geometry standards when they consider the geometric figures that lead to no solutions (figures' graphs don't intersect), one solution (the line is tangent to the quadratic), and two solutions (the line is a chord of the quadratic). The quadratics are not restricted to be circles or parabolas, though ellipses and hyperbolas are only in additional standards.

Instructional Resources

Illustrative Mathematics Assessment Tasks	Lesson Resources
A Linear and Quadratic System This task asks students to consider the linear and quadratic functions shown on a graph, and use quadratic functions to find the coordinates.	•

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The Circle and the Line This lesson is assessing a simple but important piece of conceptual understanding, namely the correspondence between intersection points of the two graphs and solutions of the system	

Algebra 1 Honors	**Unit 13: Construct and compare linear, quadratic, and exponential models and solve problems.**	8 days: 3/25-4/3

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.912.F-LE.1.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals. b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.	• Exponential functions should be in the form $a(b)^x + k$. Calculator: **NO** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multi-select • Open response
MAFS.912.F-LE.1.2 (***Testing also assesses MAFS.912.F-BF.1.1, MAFS.912.F-IF.1.3***) Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph and a description of a relationship or two input-output pairs (include reading these from a table.)	• In items that require the student to construct arithmetic or geometric sequences, the real-world context should be discrete. • In items that require the student to construct a linear or exponential function, the real-world context should be continuous. Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Multiple Choice • Multi-Select • Open Response • Table Item
MAFS.912.F-LE.1.3 Observing using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.	• Exponential functions represented in graphs or tables should be able to be written in the form $a(b)^x + k$. • For exponential relationships, tables or graphs must contain at least one pair of consecutive values. Calculator: **NO** • Editing Task Choice • Equation Editor • GRID • Hot Text • Multiple Choice • Multi-Select • Open-Response
MAFS.912.F-LE.2.5 Interpret the parameters in a linear or exponential function in terms of a context.	• Exponential functions should be in the form $a(b)^x + k$. Calculator: **NO** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multi-select • Open response

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)
• Chapter 7: Exponents and Exponential Functions

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Using the textbook is not always meeting the depths of the new standards that is why other resources are provided

- Lesson 5: Exponential Functions
- Lesson 6: Growth and Decay
- Lesson 7: Geometric Sequences as Exponential Functions

Algebra Nation

- Observations from a Graph of a Quadratic Function
- Nature of the Solutions of Quadratic Equations and Functions
- Graphing Quadratic Functions Using a Table
- Graphing Quadratic Functions Using the Vertex and Intercepts
- Graphing Quadratic Functions Using Vertex Form – Part 1
- Graphing Quadratic Functions Using Vertex Form – Part 2
- Exponential Functions
- Graphs of Exponential Functions – Part 1
- Graphs of Exponential Functions – Part 2
- Growth and Decay Rates of Exponential Functions

EngageNY Instructional Resource (may not cover all content required for the aligned standards)

- Algebra 1 Module 3, Topic A, Lesson 4
- Algebra 1 Module 3, Topic A, Lesson 5
- Algebra 1 Module 3, Topic A, Lesson 6
- Algebra 1 Module 3, Topic A, Lesson 7
- Algebra 1 Module 3, Topic D, Lesson 22
- Algebra 1 Module 3, Topic D, Lesson 23
- Algebra 1 Module 3, Topic D, Lesson 24
- Algebra 1 Module 5, Topic B, Lesson 4
- Algebra 1 Module 5, Topic B, Lesson 5
- Algebra 1 Module 5, Topic B, Lesson 6
- Algebra 1 Module 5, Topic B, Lesson 7
- Algebra 1 Module 5, Topic B, Lesson 8
- Algebra 1 Module 5, Topic B, Lesson 9

Decoded Standard

MAFS.912.F-LE.1.1

a. Students may use tables or graphs to investigate the rate of change of linear functions. While students may recognize that linear functions grow by adding the same constant difference over equal-sized intervals, proving the relationship means moving beyond examples and generalizing by using variable expressions. Likewise, students will find that exponential functions grow by multiplying by equal factors over equal intervals and then must use variable expressions to create a proof. (*Common Core Mathematics Companion*, Pg. 194)

b. Students examine the input and output for a context to determine if the rate of change involves adding a constant (positive or negative) for equal units of change in the input. Students connect this type of growth to linear functions (and, for appropriate integer inputs, to an arithmetic sequence). (*Common Core Mathematics Companion*, Pg. 196)

c. Students use contextual situations to determine if a situation is exponential and then to recognize whether a given situation represents decay or growth. (*Common Core Mathematics Companion*, Pg. 197)

Instructional Resources

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Mathematics Formative Assessments (MFAS)	Lesson Resources

Linear of Exponential? – (identify each verbal description as linear or exponential, 4 problems)
Prove Linear – (prove that a linear function grows by equal differences, 2 problems)
Prove Exponential – (prove that an exponential function grows by equal factors, 2 problems)
How Does Your Garden Grow? – (compare the rate of change in linear and exponential, 4 problems)
Predicting your Financial Future Students can use the formula to predict future value of an investment
 	
Illustrative Mathematics Assessment Tasks
In the billions and linear modeling Deeper connections for real world application of nonlinear functions.
Linear or Exponential Students analyze linear functions and nonlinear functions to determine understanding.
Exponential Functions Task asks students to think about the exponential function increases by a multiplicative factor of b when x increases by 1.
U.S Population 1982-1988 Students look at a linear model to examine population growth.
Equal Factors over Equal intervals Helps deepen understanding of Exponential functions with introducing "successive quotient" terminology.
	• MARS/Shell
	  ○ Functions and Everyday Situations This is a lesson that develops depth of understanding of functions through interpretation, identifying and analyzing situations that make up functions.
	  ○ Comparing Investments Helps students interpret and analyze contextual exponential and linear functions

Decoded Standard	
MAFS.912.F-LE.1.2 Students apply the skills and concepts they have learned for linear and exponential functions to make functions based on information from multiple representations. Though the standard states a "description of a relationship," the implication is the relationship described is a function. (*Common Core Mathematics Companion*, Pg. 198)	
Instructional Resources	
Mathematics Formative Assessments (MFAS)	Lesson Resources
Write an Exponential Function from a Table Students write an exponential function from two points in a table. Writing an Exponential Function From its Graph Students examine a graph and find the function that relates to the curve based on the given points. Illustrative Mathematics Assessment Tasks Rumors Looks at exponential growth as a matter of rumors spreading. To Points determine an Exponential Function Problem asks students to examine a graph and find an equation of the problem given two points.	• MARS/Shell ○ Comparing Investments Helps students interpret and analyze contextual exponential and linear functions

Decoded Standard
MAFS.912.F-LE.1.3 Students explore the rates of change of different functions using graphs and tables to determine a generalization for which functions grow the fastest. Students connect to their learning about average rate of change and end

behavior. (*Common Core Mathematics Companion*, Pg. 200)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources
Compare Quadratic and Exponential functions Students are asked to explain characteristics relating to the graph and interpret the graph. Compare Linear and Exponential Functions Students are asked to compare linear and exponential functions from a graph in context. Illustrative Mathematics Assessment Tasks Exponential Growth verse Linear Growth Helps students to discover how an exponential function surpasses a linear function.	• MARS/Shell ○ Comparing Investments Helps students interpret and analyze contextual exponential and linear functions

Decoded Standard

MAFS.912.F-LE.2.5

When constructing functions, students are solving problems by considering rates of change, graphs, a verbal description or sets of ordered pairs to determine if a function is linear, exponential, or quadratic. Students are asked to prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over the same interval. Students explain their choices and communicate what mathematical reasoning was involved. Students use tables and graphs to compare rates of change and to make conclusions about each family of functions. Structure and repeated reasoning occur frequently, as students look at recursive definitions to refine their understanding of linear and exponential functions. The notation and language used in all of these functions is also important, so students must be careful with the precision of their language. (*Common Core Mathematics Companion*, Pg. 204)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources
Lunch Account Students are asked to interpret linear functions parameters in a context. Computer Repair Students are expected to interpret a linear function in context to a real world situation. Interpreting Exponential Functions Students are asked to interpret parameters of an exponential function in context.	• MARS/Shell ○ Comparing Investments Helps students interpret and analyze contextual exponential and linear functions

Algebra 1 Honors	**Unit 14: Interpreting and analyzing functions.**	4 days: 4/6-4/9
Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**	
MAFS.912.F-IF.2.5 (Assessed under F-IF.1.2) Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of persons-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.	• Items may present relations in a variety of formats, including sets of ordered pairs, mapping diagrams, graphs, and input/output models. • In items requiring the student to find the domain from graphs, relationships may be on a closed or open interval. • In items requiring the student to find domain from graphs, relationships may be discontinuous. • Items may not require the student to use or know interval notation Calculator: **NEUTRAL** • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item	
MAFS.912.F-IF.2.6 (Also assesses MAFS.912.S-ID.3.7) Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.	• Items requiring the student to calculate the rate of change will give a specified interval that is both continuous and differentiable. • Items should not require the student to find an equation of a line. • Items assessing F-IF.2.6 should not be linear. Calculator: Neutral • Equation Editor • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response	
MAFS.912.F-IF.3.7 (part d is not tested) Graph functions expressed symbolically and show key features of the graph by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic-functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available and showing end behavior. d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude and using phase shift.	• Students will graph a linear function using key features. • Students will identify and interpret key features of a graph within the real-world context that the function represents. Calculator: Neutral • Equation Editor • GRID • Hot Text • Multiple Choice • Multiselect • Open Response	

MAFS.912.F-IF.3.8 (Also assesses MAFS.912.F-IF.3.7a,b,c,e and MAFS.912.A-APR.2.3) a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. b. Use the properties of exponents to interpret expressions for exponential functions.	• Students will identify zeros, extreme values, and symmetry of a quadratic functions written symbolically. • For F-IF.3.7e and F-IF.3.8b, exponential functions are limited to simple exponential growth and decay functions and to exponential functions with one translation. Base e should not be used. • For F-IF.3.8, items may specify a required form using an equation or using common terminology such as standard form. • Items that require the student to interpret the vertex or a zero of a quadratic function within a real-world context, the student should interpret both the x-value and the y-value. Calculator: Neutral • Equation Editor • GRID • Hot Text • Multiple Choice • Multiselect • Open Response
MAFS.912.F-IF.3.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions. For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.	• Functions can be linear, quadratic or exponential • Functions can be represented using tables or graphs • Functions can have closed domains • Functions can be discontinuous • Items may not require students to use or know interval notation. Calculator: **NO** • Equation Editor • GRID • Hot Text • Multiple Choice • Open Response

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)
•

Algebra Nation
• Average Rate of Change Over an Interval • Finding Solution Sets of Systems of Equations Using Tables of Values and Successive Approximations • Comparing Linear, Quadratic, and Exponential Functions – Part 1 • Comparing Linear, Quadratic, and Exponential Functions – Part 2

EngageNY Instructional Resource (may not cover all content required for the aligned standards)
• Algebra 1 Module 3, Topic B, Lesson 13 • Algebra 1 Module 3, Topic B, Lesson 14 • Algebra 1 Module 4, Topic A, Lesson 10 • Algebra 1 Module 4, Topic B, Lesson 16 • Algebra 1 Module 4, Topic B, Lesson 17 • Algebra 1 Module 4, Topic C, Lesson 18 • Algebra 1 Module 4, Topic C, Lesson 19 • Algebra 1 Module 4, Topic C, Lesson 20 • Algebra 1 Module 4, Topic C, Lesson 21

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- Algebra 1 Module 5, Topic A, Lesson 1
- Algebra 1 Module 5, Topic A, Lesson 2
- Algebra 1 Module 5, Topic A, Lesson 3

Decoded Standard

MAFS.912.F-IF.2.5

Students consider situations that have continuous and discrete domains and/or ranges. A good starting example relates the number of Rees's cups purchased versus the number of packages at the candy counter. The domain is {1, 2, 3, …} while the range is {2, 4, 6, 8, …}. The graph is linear, has a constant rate of change of 2 cups per package, and is graphed with points (discrete). This can be compare with the distance a walker going 2 miles per hour is from a starting point versus time, which is continuous. Students need to explain why each domain and range occurs. Another example considers the number of same-size buses needed to seat students. One bus holds 34 students, then two buses hold 68 students, and so on. The domain (number of buses) is a natural number. The number of students is also a natural number. If there ae 38 students, two buses are still needed, so the graph is not a typical linear function that students may be used to seeing from previous experiences.
(*Common Core Mathematics Companion*, Pg. 154)

Instructional Resources

Mathematics Formative Assessments (MFAS)

Describe the Domain Given verbal descriptions describe an appropriate domain.

Height vs. Shoe Size Students determine the domain from a context.

Car Wash Students determine the domain from a graph.

Illustrative Mathematics Assessment Tasks

The Canoe Trip The purpose of this task is to give students practice construction functions that represent a quantity in a context.

Oakland Coliseum Students find the domain and range of the given function

Additional Lesson Resources

- Algebra Nation
  - Representing, Naming, and Evaluating Functions
  - Modeling with Functions
- MARS/Shell *A culminating lesson task using a coherent approach to this unit*
  - …Functions and Everyday Situations This is a lesson that develops depth of understanding of functions through interpretation, identifying and analyzing situations that make up functions.

Decoded Standard

MAFS.912.F-IF.2.6

The *Progressions for the Common Core State Standards: 6-7 Ratios and Proportional Relationships* (2011) gives examples of rate of change involving both ratios and proportions using similar triangles to show the additive and multiplicative conceptual underpinning of the concepts (p. 5, 9). This idea is extended in Functions, starting in Grade 8, by examining not only direct variations but also other linear functions. For Grades 9-12, the average rate of change may begin with the concept of linear functions, but it is not limited to linear functions. The average rate of change is the ratio of the change in the dependent variable to the change in the independent variable for a given interval (e.g., for $1 \leq x \leq 4$ on the function $f(x) = x^2$, the average rate of change $= \frac{f(4)-f(1)}{4-1} = \frac{16-1}{3} = \frac{15}{3} = 5$). For students moving into STEM careers, this work links to the difference quotient and the instantaneous rate of change (an application of the derivative in calculus). (*Common Core Mathematics Companion*, Pg. 155)

Instructional Resources

Mathematics Formative Assessments (MFAS)

Pizza Palace – (Rate of change, 2 problems)

Identifying Rate of Change – (Identifying Rate of Change, 3 problems)

Additional Lesson Resources

- Algebra Nation
  - Average Rate of Change Over An Interval
  - Comparing Linear, Quadratic, and

Air Cannon – (Rate of change given exponential graph, 3 problems) Estimating the Average Rate of Change – (Non-linear rate of change, 3 problems) Illustrative Mathematics Assessment Tasks The High School Gym—task build student reasoning skills for examining linear and non linear relationships Mathmafish Population—interpreting a real world problem for linear relationships at intervals.	Exponential Functions – Part 1 ○ Comparing Linear, Quadratic, and Exponential Functions – Part 2 • MARS/Shell ○ Functions and Everyday Situations This is a lesson that develops depth of understanding of functions through interpretation, identifying and analyzing situations that make up functions.

Decoded Standard
MAFS.912.F-IF.3.7 A. *Common Core Mathematics Companion*, Pg. 158 B. *Common Core Mathematics Companion*, Pg. 160 C. *Common Core Mathematics Companion*, Pg. 162 D. *Common Core Mathematics Companion*, Pg. 163 E. *Common Core Mathematics Companion*, Pg. 165

Instructional Resources	
Mathematics Formative Assessments (MFAS) Graphing a Step Function students graph a step function state the domain and identify intercepts. Graphing a Quadratic Function Students graph a quadratic function and identify the intercepts and the maxima or minima. Graphing a Rational Function Students graph equations using technology and answer questions about key features. Graphing a Linear Function Students are given equations and asked to identify domains and with limits what are the maximum and minimum and intercepts. Graphing a Root Function Students answer questions about the domain, maxima and minima of Root functions. Graphing an Exponential Function Students graph an exponential function and to determine if the function is an example of exponential growth or decay, describe any intercepts, and describe the end behavior of the graph. Exponential Graphing using Technology Allows students to use technology to examine what happens when values are changed and how it affects the graph. Illustrative Mathematics Assessment Tasks Graphs of Quadratic Functions Students compare graphs of different quadratic functions, then produce equations of their own to satisfy given conditions.	Additional Lesson Resources • Algebra Nation ○ • MARS/Shell *A culminating lesson task using a coherent approach to this unit* ○ …Functions and Everyday Situations This is a lesson that develops depth of understanding of functions through interpretation, identifying and analyzing situations that make up functions. ○ Comparing Investments Helps students interpret and analyze contextual exponential and linear functions

Decoded Standard
MAFS.912.F-IF.3.8 A. This connects directly to A-SSE.2.3a and A-SSe.2.3b, as well as F-IF.3.7a. Students write expressions in equivalent forms for quadratics by using factoring and completing the square. From these equivalent forms,

students can determine whether a quadratic opens up or down (therefore identifying maximum or minimum values) and where the axis of symmetry is (using $f(x) = p(x - h)^2 + k$ allows students to see the axis of symmetry is at $x = h$). The factored form can be set equal to zero to find the zeros of the function. Students can verify all of these different properties of the function by looking at the graph of the function. When given a context, such as projectile motion graphed using time versus height, students can interpret the zeros as the times where the projectile is at height zero, the extreme as the maximum height of the projectile, and the axis of symmetry as an imaginary line that shows the symmetry between the projectile's upward and downward motion. (*Common Core Mathematics Companion*, Pg. 168)

B. Students use concepts from graphing in F-IF.3.7e and F-LE.1.1c to interpret the meaning of exponential functions. When the base is less than one, the graph falls as *x* increases. The function never gets to zero, though it is very close, so students recognize exponential decay. When the base is more than one, the graph rises as *x* increases (at an increasingly faster average rate of change), so students recognize exponential growth. (*Common Core Mathematics Companion*, Pg. 169)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Lesson Resources
Exponential Functions 1 Students are asked to identify the percent rate of change and determine if it is decay or growth. Exponential Functions 2 Students are asked to identify the percent rate of change and determine if it is decay or growth. Launch from a Hill Students are asked to factor and find the zeros of a polynomial function given in context. A Home for Fido Students are asked to rewrite a quadratic function in an equivalent form by completing the square and to use this form to identify the vertex of the graph and explain its meaning in context. Illustrative Mathematics Assessment Tasks Springboard Dive The student will gain valuable experience applying the quadratic formula and the exercise also gives a possible implementation of completing the square. Which Function The task addresses knowledge related to interpreting forms of functions derived by factoring or completing the square.	• Algebra Nation

Decoded Standard

MAFS.912.F-IF.3.9
Students are extending their fluency with function notation and representation. Students may compare a symbolic representation of a function with a tabular version of another function or compare a graph with a verbal description as examples of what may occur in this standard. (*Common Core Mathematics Companion*, Pg. 170)

Instructional Resources

Mathematics Formative Assessments (MFAS)	Additional Lesson Resources

	• Algebra Nation
	  ○ Comparing Linear, Quadratic, and Exponential Functions – Part 1
	  ○ Comparing Linear, Quadratic, and Exponential Functions – Part 2
	• MARS/Shell

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	○ Functions and Everyday Situations This is a lesson that develops depth of understanding of functions through interpretation, identifying and analyzing situations that make up functions.

Algebra 1 Honors	**Unit 15: Build a function that models a relationship between two quantities.**	4 days: 4/13-4/17

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.912.F-BF.1.1 Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context. b. Combine standard function types using arithmetic operations. c. Compose Functions.	• In items where the student must write a function using arithmetic operations or by composing functions, the student should have to generate the new function only. Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Multiple Choice • Multi-Select • Open Response • Table Item
MAFS.912.F-BF.1.2 (Algebra 2 tested standard) Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.	• Calculator: •
MAFS.912.A-SSE.2.4 (Algebra 2 tested standard) Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems.	• Calculator: •

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)
•

Algebra Nation
• Finding Zeros of Polynomial Functions of Higher Degrees • End Behavior of Graphs of Polynomials • Graphing Polynomial Functions of Higher Degrees • Recognizing Even and Odd Functions • Solutions to Systems of Functions

EngageNY Instructional Resource (may not cover all content required for the aligned standards)
• Algebra 1 Module 1, Topic D, Lesson 26 • Algebra 1 Module 1, Topic D, Lesson 27

Decoded Standard
MAFS.912.F-BF.1.1 A. Students use contextual situations and sets of ordered pairs to create functions to describe the relationship. This standard is used when students fit curves to data in the Statistics conceptual category. (*Common Core Mathematics Companion*, Pg. 177) B. Students apply their understanding of the algebra of expressions and the algebra of creating equations to situations that combine existing functions. This standard adds to the ideas in F-IF.3 of graphing and recognizing key characteristics by having the students write the function and use their algebraic skills to do so. (*Common Core Mathematics Companion*, Pg. 178) C. This is an additional standard that implies an understanding of the composition of functions. The use of

contexts is needed so that students have more than a symbolic reference to what composition involves. Two ways students can consider compositions are with graphs and symbols. (*Common Core Mathematics Companion*, Pg. 180)

Instructional Resources	
Mathematics Formative Assessments (MFAS) Saving for a Car Students write an explicit function rule given a verbal description Giveaway Students write an explicit function from a verbal description and use it to answer questions. Furniture Purchase Students writes 2 explicit function from verbal descriptions and answers questions Illustrative Mathematics Assessment Tasks Graphs of Compositions Students work with compositions to address important issues around inverse functions. Sum of functions This lesson asks students to think about how adding functions works at a fundamental level.	Additional Lesson Resources

Decoded Standard	
MAFS.912.F-BF.1.2 *(Algebra 2 Tested Standard)* When given an addition/subtraction pattern or a multiplication/division sequence, students will recognize an arithmetic (add a common difference each time) or geometric sequence (multiply by a common ratio each time) and be able to create both recursive and explicit functions for the pattern. (*Common Core Mathematics Companion*, Pg. 181)	
Instructional Resources	
Illustrative Mathematics Assessment Tasks Snake on a Plane Students look at functions via recursive and algebraic definitions.	Additional Lesson Resources • CPalms ○ Temperatures in Degrees Fahrenheit and Celsius The first part of this task provides an opportunity to construct a linear function given two input-output pairs. The second part investigates the inverse of a linear function while the third part requires reasoning about quantities and/or solving a linear equation. ○ Plants versus Pollutants Model Eliciting Activity Students work together to clean up toxins through mathematical analysis identifying sequence.

Decoded Standard	
MAFS.912.A-SSE.2.4 *(Algebra 2 Tested Standard)* *Common Core Mathematics Companion*, Pg. 86	
Instructional Resources	
	Lesson Resources •

Algebra 1 Honors	**Unit 16: Building new functions from existing functions.**	3 days: 4/20-4/22

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.912.F-BF.2.3 Identify the effect on the graph of replacing the f(x) by f(x) + k,k f(x), f(kx) and f(x +k), for specific values of k (both positive and negative); find the value of k given he graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology, include recognizing even and odd functions from their graphs and algebraic expressions for them.	• Functions represented algebraically are limited to linear, quadratic, or exponential. • Functions represented using tables or graphs are not limited to linear, quadratic, or exponential. • Functions may be represented using tables or graphs. • Functions may have closed domains. • Functions may be discontinuous. Items should have a single transformation. Calculator: Neutral • Equation Editor • GRID • Matching Item • Multiple Choice • Open Response • Table Item
MAFS.912.F-BF.2.4 **(Algebra 2 tested standard)** Find inverse functions. a. Solve an equation of the form f(x)=c for a simple function f that has an inverse and write an expression for the inverse. For example, f(x)=2x^3 or f(x) = (x+1)/(x-1) for ≠1. b. Verify by composition that one function is the inverse of another. c. Read values of an inverse function from a graph or a table, given that the function has an inverse. d. Produce an invertible function from a non-invertible function by restricting the domain.	• Calculator: •

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)
•

Algebra Nation
• Transformation of Functions • Transformations of the Dependent Variable of Quadratic Functions • Transformations of the Independent Variable of Quadratic Functions • Transformations of Exponential Functions

EngageNY Instructional Resource (may not cover all content required for the aligned standards)
• Algebra 1 Module 3, Topic C, Lesson 15 • Algebra 1 Module 3, Topic C, Lesson 16 • Algebra 1 Module 3, Topic C, Lesson 17 • Algebra 1 Module 3, Topic C, Lesson 18 • Algebra 1 Module 3, Topic C, Lesson 19 • Algebra 1 Module 3, Topic C, Lesson 20 • Algebra 1 Module 3, Topic D, Lesson 21 • Algebra 1 Module 3, Topic D, Lesson 22

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- Algebra 1 Module 3, Topic D, Lesson 23
- Algebra 1 Module 3, Topic D, Lesson 24

Decoded Standard

MAFS.912.F-BF.2.3

Students use graphing calculators or technology such as Desmos to experiment with a parent function and the results when different transformations are applied. This standard aligns well with F-BF.1.1b in which arithmetic of functions was considered (adding a constant to a function is the same as adding a constant function to the function). Students connect the effects to related geometric transformations: translations and dilations. Students also consider the effect of replacing *x* with –*x* - that is, they compare $f(x)$ with $f(-x)$. The results of those investigations are used to help students define even and odd functions algebraically. Students also investigate graphs of even and odd functions so they may recognize new functions as even or odd, and so they can generalize graphic and symbolic characteristics of even and odd functions. This standard also aligns with F-IF.3 and the different families of functions, as new functions may be created from the parent function by applying transformations. (*Common Core Mathematics Companion*, Pg. 183)

Instructional Resources

Mathematics Formative Assessments (MFAS)

Write the equation Students are asked to write the function of three absolution value graphs.

Comparing functions Students are asked to compare functions to a given function to help see transformations

Comparing Functions - Quadratic Students compare the graphs of quadratics to the parent graph.

Illustrative Mathematics Assessment Tasks

Medieval Archer This activity helps examine the vertical and horizontal changes placed upon the changing functions.

Transforming the graph of a function Allows students to follow the shifts and recognize patterns in terms of functions.

Building a Quadratic Function from f(x)=x^2 This task aims for students to understand the quadratic formula in a geometric way in terms of the graph of a quadratic function.

Medieval Archer Students will identify the effect on the graph of replacing f(x) by f(x) + k, kf(x), f(kx), and f(x + k) for specific values of k (both positive and negative).

Building a General Quadratic Function This task is for instructional purposes only and builds on "Building an explicit quadratic function."

Lesson Resources

- CPalms
  - Translating Quadratic Functions Students will examine what happens to the graph as it is modified in four different ways
  - Graphing Quadratic Equations This lesson uses graphing technology to examine the differences between quadratic equations and linear equations.

Decoded Standard

MAFS.912.F-BF.2.4a

A. Students connect back to pairs of arithmetic operations, such as adding and subtracting and of functions, such as squaring and square rooting, to understand inverse functions. The concept students begin with is that inverse functions undo each other. Once the concept is learned, students examine graphs of inverse functions to reach an understanding that the ordered pair (*x*, *y*) on one function is the ordered pair (*y*, *x*) on its inverse. Students also can see that inverse functions are reflections of each other over the line *x*=*y*. Use of MIRA's , paper folding, and patty paper can then be used to assist students in finding the graph of the inverse of a given function and verify one function is the inverse of another. By using the understanding that the ordered pair (*x*, *y*) is reversed, students create ways to find the inverse of some functions algebraically. (*Common Core Mathematics Companion*, Pg. 185)

B, C, D. These are small grain size standards. Since students have learned about composition, undoing can be demonstrated by composing f and f^{-1} to get back a given specific input or the general *x* value. By using the concept of the ordered pair being reversed in the inverse functions, students can look at a table of values of $f(x)$ and create ordered pairs for f^{-1}. (*Common Core Mathematics Companion*, Pg. 186)

Instructional Resources	
<u>Mathematics Formative Assessments (MFAS)</u>	<u>Additional Lesson Resources</u> • MARS/Shell • Generalizing Patterns—this task ask students to explain their rational behind their method in describing patterns

Algebra 1 Honors	**Unit 17: Summarize, represent, and interpret data on two categorical and quantitative variables.**	3 days: 4/23-4/27

Standards/Learning Goals:	**Content Limits, Assessment Types, Calculator**
MAFS.912.S-ID.2.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data	• In data with only two categorical variables, items should require the student to determine relative frequencies and use the frequencies to complete the table or to answer questions. Calculator: **YES** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item
MAFS.912.S-ID.2.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models. b. Informally assess the fit of a function by plotting and analyzing residuals. c. Fit a linear function for a scatter plot that suggests a linear association	• In items that require the student to interpret or use the correlation coefficient, the value of the correlation coefficient must be given in the stem. Calculator: **NEUTRAL** • Editing Task Choice • Equation Editor • GRID • Hot Text • Matching Item • Multiple Choice • Multiselect • Open Response • Table Item

McGraw-Hill Instructional Resource (may not cover all content required for the aligned standards)
•

Algebra Nation
• Relationship between Two Categorical Values – Marginal and Joint Relative Frequency – Part 1 • Relationship between Two Categorical Values – Marginal and Joint Relative Frequency – Part 2 • Relationship between Two Categorical Values – Conditional Frequency • Scatter Plots and Function Models • Residuals and Residual Plots – Part 1 • Residuals and Residual Plots – Part 2

EngageNY Instructional Resource (may not cover all content required for the aligned standards)
• Algebra 1 Module 2, Topic C, Lesson 9 • Algebra 1 Module 2, Topic C, Lesson 10 • Algebra 1 Module 2, Topic D, Lesson 16 • Algebra 1 Module 2, Topic D, Lesson 17 • Algebra 1 Module 2, Topic D, Lesson 18

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Decoded Standard

MAFS.912.S-ID.2.5
Common Core Mathematics Companion, Pg. 359

Instructional Resources

Mathematics Formative Assessments (MFAS)

Breakfast Drink Preference Students are asked to use data from a survey to create a two-way frequency table.
Who is Vegetarian Students are given a two-way frequency table and asked to determine if there is a relationship between the two variables.
Conditional Relative Frequency Students are asked to use a two-way frequency table to interpret two different conditional relative frequencies.
Marginal and Joint Frequency Students are asked to use a two-way frequency table to interpret marginal and joint relative frequencies.

Illustrative Mathematics Assessment Tasks

Musical Preferences This problem solving task asks students to make deductions about what kind of music students like by examining a table with data.
Can You Make Heads or Tails of It? This is a lesson for teaching students how to make Two-Way Frequency and Relevant Frequency tables and to use the data collected and displayed in the tables for interpretation and prediction.

Lesson Resources

- CPalms
  - The Music is On and Popping This MEA is designed to have teams of 4 students look at data in a two-way table.
  - Show me the Money This lesson is an application activity in which students will use relative frequencies to support an argument.
  - Devising a Measure for Correlation This lesson unit is intended to help you assess how well students understand the notion of correlation

Decoded Standard

MAFS.912.S-ID.2.6

A. *Common Core Mathematics Companion*, Pg. 361
B. *Common Core Mathematics Companion*, Pg. 363
C. *Common Core Mathematics Companion*, Pg. 366

Instructional Resources

Mathematics Formative Assessments (MFAS)

Swimming Prediction Students are asked to use a linear model to make and interpret predictions in the context of the data.
Fit a Function Students are given a set of data and are asked to use technology to create a scatter plot and write a function that fits the data set.
Residuals Students are asked to compute, graph, and interpret the residuals associated with a line of best fit.
House Prices Students are asked to informally fit a line to model the relationship between two quantitative variables in a scatterplot, write the equation of the line, and use it to make a prediction.

Additional Lesson Resources

- Illuminations
  - Barbee Bungee In this lesson students collect data using a rubber band bungee cord and a Barbie doll, construct a scatter plot, generate a line of best fit, and consequently examine linear functions
- CPalms
  - Doggie Data: It's a dogs life This lesson allows students to use real-world data to construct and interpret scatter plots using technology.
- MARS/Shell
  - Devising a Measure for Correlation This lesson unit is intended to help you assess how well students understand the notion of correlation.

MS Math Scoring Criteria (Grade 8 Math)

Number and Quantity: Reason, describe, and analyze quantitatively, using units and number systems to solve problems.				
Scoring Criteria				
Performance Indicators	**Emerging**	**Progressing**	**Meets**	**Exceeds**
G. Students will know that there are numbers that are not rational, and approximate them by rational numbers [8.NS.1.1, 8.NS.1.2]	i. Students can find the square roots of small perfect squares.	i. Students can identify square roots of non-square numbers and pi as irrational numbers; identify rational or irrational numbers and convert familiar rational numbers with one repeating digit to fraction form.	i. Students can place irrational numbers on a number line; identify irrational decimal expansions as approximations; identify rational and irrational numbers and convert less familiar rational numbers to fraction form.	i. Students can use approximations of irrational numbers to estimate the value of an expression; compare and order rational and irrational numbers without a number line.

Algebra: Create, interpret, use, and analyze expressions, equations and inequalities.				
Scoring Criteria				
Performance Indicators	**Emerging**	**Progressing**	**Meets**	**Exceeds**
F. Students will work with radicals and integer exponents. [8.EE.1.1, 8.EE.1.2, 8.EE.1.3, 8.EE.1.4]	i. Students can identify numbers in scientific notation as being a very large number (positive exponent) or a very small number (negative exponent).	i. Students can apply the properties of natural number exponents to generate equivalent numerical expressions. ii. Students can evaluate square roots and solve mathematical equations in the form $x^2 = p$, where p is a positive rational number and is a small perfect square; knows that square root 2 is irrational. iii. Students can use numbers expressed in the form of a single digit times an integer power of 10 to express very large numbers. iv. Students can represent very large and very small	i. Students can apply the properties of integer exponents to generate equivalent numerical expressions. ii. Students can use square root and cube root symbols to represent solutions to mathematical equations in the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number; evaluate cube roots of small perfect cubes. iii. Students can use numbers expressed in the form of a single digit times an integer power of 10 to express very small numbers. iv. Students can perform operations	i. Students can use multiple properties of integer exponents within an expression; analyze the reasonableness of the result of using the properties of integer exponents. ii. Students can write and solve equations representing real-world situations using square root and cube root symbols; justify how square roots and cube roots relate to each other and to their radicands. iii. Students can express how many times as much a number written in the form of a single digit times

		quantities in scientific notation and use units of appropriate sixe for measurements of very large or very small quantities.	with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used; interpret scientific notation generated by technology.	an integer power of 10 is than another number written in the same form. iv. Students can perform operations and interpret values written in scientific notation within a real-world context; analyze the process and solution to given problems using scientific notation.
G. Students will understand the connections between proportional relationships, lines, and linear equations. [8.EE.2.5, 8.EE.2.6]	i. Students can graph a proportional relationship given a table. ii. Students can identify the slope of a line when given an equation in slope-intercept form.	i. Students can graph proportional relationships, interpreting the unit rate as the slope. ii. Students can determine the slope of a line given a graph.	i. Students can identify the unit rate as the slope; compare two different proportional relationships represented in different ways. ii. Students can explain, using similar triangles, why the slope is the same between any two distinct points on a nonvertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin.	i. Students can generate a model of a proportional relationship given specific quantities. ii. Students can derive the equation $y = mx + b$ for a line intercepting the vertical axis at b; compare and contrast situations in which similar triangles would or would not yield the same slope between two distinct points on a nonvertical line in the coordinate plane.
H. Students will analyze and solve linear equations and pairs of simultaneous linear equations. [8.EE.3.7, 8..EE.3.8]	i. Students can use substitution with an equation or pair of equations and a data set to determine if any number(s) from the data set makes the equation true.	i. Students can solve linear equations with integer coefficients and variables on one side. ii. Students can interpret mathematical or real-world problems given the graph, of a system of two linear equations in two variables.	i. Students can solve multistep linear equations in one variable with rational coefficients using the distributive property or collecting like terms on a given side; identify linear equations as having solution of one,	i. Students can justify why an equation has one solution, infinitely many solutions, or no solution; create examples of equations that have one solution, infinitely many solutions, or no solution.

			infinitely many, or none by transforming the given equation into simpler forms by inspection. ii. Students can solve mathematical and real-world systems of two linear equations in two variables with integer coefficients by inspection, algebraically by multiplying only one of the equations by an integer.	ii. Students can solve and analyze a system of equations in two variables with integer and benchmark fraction coefficients; solve and analyze problems involving two linear equations in two variables with rational coefficients or constants.

Functions: Use various forms of functions to interpret and analyze a variety of contexts.				
Scoring Criteria				
Performance Indicators	**Emerging**	**Progressing**	**Meets**	**Exceeds**
A. Students will define, evaluate, and compare functions. [8.F.1.1, 8.F.1.2, 8.F.1.3]	i. Students can define the terms function, linear, nonlinear, and slope.	i. Students can identify, from a graph, if a relation is a function. ii. Students can compare properties (i.e., slope, y-intercept, values) of two linear functions represented in a different way (graph and equation in slope intercept form). iii. Students can determine whether a function is linear or nonlinear from a graph.	i. Students can use a table or graph to demonstrate understanding that a function is a rule that assigns to each input exactly one output and that the graph of a function is the set of ordered pairs consisting of an input and the corresponding output. ii. Students can compare properties (i.e., slope, y-intercept, values) of two linear functions each represented in a different way (algebraically, graphically, numerically in tables, or verbal description). iii. Students can interpret the	i. Students can explain, given a rule, why it is a function or not a function; create a rule, given a table or graph, and explain why it is or is not a function. ii. Students can compare two linear functions and justify whether two functions each represented in a different way (algebraically, graphically, numerically in tables, or verbal description) are equivalent or not by comparing properties; create a function, based on given criterion,

			equation $y = mx + b$ as defining a linear function whose graph is a straight line.	in comparison to a given function. ii. Students can determine whether a function is linear or nonlinear (table or equation); give real-world examples of functions that are linear or nonlinear.
B. Students will use functions to model relationships between quantities. [8.F.2.4, 8.F.2.5]	i. Students can determine the rate of change given points on a coordinate plane.	i. Students can determine the rate of change from two (*x*, *y*) values or from a graph. ii. Students can describe qualitatively the functional relationship between two quantities by analyzing some features of a graph to be linear and nonlinear.	i. Students can interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values; construct a function to model a linear relationship between two quantities. ii. Students can describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g, where the function is increasing or decreasing, linear or nonlinear).	i. Students can interpret the rate of change and initial value of a linear function in terms of a verbal description of the linear function; analyze a set of values in either a table or graph to determine changes to be made to make the relationship linear. ii. Students can sketch a graph that exhibits given qualitative features of a function; interpret qualitative features of a function in a context.

Geometry: Understand geometric concepts and constructions, prove theorems, and apply appropriate results to solve problems.				
Scoring Criteria				
Performance Indicators	**Emerging**	**Progressing**	**Meets**	**Exceeds**
D. Students will understand congruence and similarity using physical	i. Students can define/explain the terms translation, rotation,	i. Students can describe a rigid transformation between two congruent figures	i. Students can describe a sequence of up to two rigid transformations	i. Students can use properties of rigid and non-rigid transformations to understand the

models, transparencies, or geometry software. [8.G.1.1, 8.G.1.2, 8.G.1.3, 8.G.1.4, 8.G.1.5]	reflection, and dilation.	that exhibit the congruence between them. ii. Students can describe the effect of a reflection or translation on two-dimensional figures using coordinates.	between two congruent figures. ii. Students can describe the effect of a dilation, translation, rotation, or reflection on two-dimensional figures using coordinates and coordinate notation. iii. Students can identify a sequence of transformations and a dilation that results in similarity.	relationship between transformations and congruence. ii. Students can describe the effect of up to two rigid transformations on two-dimensional figures using coordinates; describe the effect of two transformations, including at least one dilation, on two-dimensional figures using coordinates and coordinate notation. iii. Students can describe a sequence of transformations and a dilation that results in similarity.
E. Students will understand and apply the Pythagorean Theorem. [8.G.2.6, 8.G.2.7, 8.G.2.8]	i. Students can recall the equation for the Pythagorean Theorem.	i. Students can use the Pythagorean Theorem and apply to right triangles. ii. Students can calculate hypotenuse length using the Pythagorean Theorem, given a picture of a right triangle or the lengths of the two legs.	i. Students can model and explain the proof of the Pythagorean Theorem and its converse using a pictorial representation. ii. Students can calculate unknown side lengths using the Pythagorean Theorem; apply the Pythagorean Theorem to find the distance between two points in a coordinate system with the right triangle drawn.	i. Students can apply the Pythagorean Theorem to a real-world situation in two and three dimensions to determine unknown side lengths or the distance between two points in a coordinate system. ii. Students can find multiple leg lengths given a hypotenuse of an isosceles triangle or find multiple leg lengths when two triangles with the same hypotenuse are given; apply the Pythagorean Theorem in multistep problems; find the coordinates of a point which is a given distance

				(nonvertical and nonhorizontal) from another point.
F. Students will solve real-world and mathematical problems involving volume of cylinders, cones, and spheres. [8.G.3.9]	i. Students can identify three dimensional figures as cones, cylinders or spheres.	i. Students can recall the formulas for finding the volume of cones, cylinders and spheres.	i. Students can use the formulas for the volume of cones, cylinders, and spheres to solve real-world and mathematical problems.	i. Students can explain and justify the relationship between formulas for the volume of cones, cylinders, or spheres; explain the derivation of the formulas for cones, cylinders, and spheres.

Statistics and Probability: Interpret and apply statistics and probability to analyze data, reach and justify conclusions, and make inferences.				
Scoring Criteria				
Performance Indicators	**Emerging**	**Progressing**	**Meets**	**Exceeds**
F. Students will investigate patterns of association in bivariate data. [8.SP.1.1, 8.SP.1.2, 8.SP.1.3, 8.SP.1.4]		i. Students can construct a scatter plot and describe the pattern as positive, negative, or no relationship. ii. Students can identify a straight line used to describe a linear association on a scatter plot. iii. Students can identify the slope and y-intercept of a linear model on a scatter plot, given an equation. iv. Students can interpret a two-way table by row or column.	i. Students can conduct and interpret scatter plots for bivariate measurement data to investigate patterns of association between quantities. ii. Students can draw a straight line on a scatter plot that closely fits the data points. iii. Students can interpret the slope and intercept, given context. iv. Students can complete a two-way table of categorical data.	i. Students can describe patterns such as outliers and nonlinear associations. ii. Students can judge how well the trend line fits the data; compare more than one trend line for the same scatter plot and justify the best one. iii. Students can use the equations of a linear model to solve problems in the context of bivariate measurement data; create and use a linear model based on a set of bivariate data to solve a problems involving slope and intercept. iv. Students can construct and/or

				interpret a two-way table to summarize data; describe and/or compare relative frequencies.

Competency #1: Algebra and the Number System
The student creates, interprets, uses, and analyzes patterns of algebraic structures to make sense of problems

Success Criteria				
Performance Indicators	**Emerging**	**Progressing**	**Proficient**	**Exceeds**
a. Interpret the structure of expressions and rewrite expressions in equivalent forms for both real-world and mathematical contexts *A-SSE.1.1, 1.2, 2.3*	The student defines and identifies parts of an expression.	The student explains the meanings of the different parts of an expression according to the context of a real-world problem.	The student interprets the structure of expressions and rewrites expressions in equivalent forms for both real-world and mathematical contexts.	The student can interpret the parts of an expression given in any form.
b. Perform arithmetic operations and apply an understanding of closure on polynomials, understand the relationship between zeros and factors of polynomials, and use the zeros to sketch a graph of polynomials. *A-APR.1.1, 2.3*	The student performs arithmetic operations on one variable polynomials with no more than 3 terms.	The student performs arithmetic operations on polynomials and understands the relationship between zeros and factors of polynomials.	The student performs arithmetic operations on polynomials, understands the relationship between zeros and factors of polynomials, and uses the zeros to sketch a graph of polynomials. The student applies an understanding of closure to polynomial operations.	The student models a given situation using polynomials. The student graphs a polynomial by first factoring in order to identify zeros.
c. Create equations and inequalities (including systems) in two or more variables from a real-world context to describe numbers or relationships, and rearrange a formula representing a real-world relationship to solve for a variable. *A-CED.1.2, 1.3, 1.4*	The student identifies variables to represent unknown quantities in a real-world context.	The student chooses from a list of equations or inequalities in two variables from a real-world context to describe numbers, relationships, or constraints. The student rearranges a formula with one procedural step to solve for a variable.	The student creates equations and inequalities (including systems) in two or more variables from a real-world context to describe numbers, relationships, or constraints. The student rearranges a formula representing a real-world relationship to solve for a variable.	The student creates a formula to describe a real-world relationship.
d. The student creates and solves equations and inequalities in one variable and can explain each step.	The student solves one and two step linear equations.	The student selects an equation or inequality in one variable to represent a real-world situation.	The student creates an equation or inequality in one variable to represent a real-world situation.	The student can derive the quadratic formula by completing the square.

The student rewrites quadratic equations by completing the square and can complete a proof of the quadratic formula using this method. *A-REI.1.1, 2.3, 2.4* *A-CED.1.1*		The student solves equations (both linear and quadratic) in one variable.	The student solves equations (both linear and quadratic) and inequalities (simple and compound) in one variable and can explain each step when solving linear equations. The student rewrites quadratic equations by completing the square and can complete a proof of the quadratic formula using this method.	
e. Solve and verify the solution to a system of equations or inequalities via algebraic process, table, graph or successive approximations, and can confirm if two systems of equations are equivalent using linear combination. *A-REI.3.5, 3.6, 4.10, 4.11, 4.12*	The student can verify the solution to a system of equations or inequalities by inspection.	The student explains the difference in the methods of solving systems of equations and inequalities and can solve using one of the methods.	The student can solve and verify the solution to a system of equations or inequalities via algebraic process, table, graph or successive approximations. The student can provide steps for the algebraic process of linear combination and can confirm if two systems of equations are equivalent using linear combination.	The student distinguishes the most efficient way to solve a system of equations and justifies their reasoning. The student can construct a proof of the algebraic process of linear combination.
f. Simplify radical expressions, and use the properties of exponents to rewrite expressions. Apply an understanding of closure to operations with rational and irrational numbers. *N-RN.1.1, 1.2, 2.3*	The student can identify perfect squares. The student can use the properties of exponents to rewrite expressions with integer exponents. The student can identify rational and irrational numbers.	The student can rewrite a square root as an expression with a rational exponent. The student can identify perfect squares and perfect cubes. The student can recall the properties of exponents. The student applies an understanding of closure to operations with rational numbers.	The student can rewrite a radical as an expression with a rational exponent. The student can rewrite a square root so that the radicand has no square factors. The student can use the properties of exponents to rewrite expressions with rational exponents. The student applies an understanding of closure to operations with rational and irrational numbers.	The student can rewrite expressions with radicals or rational exponents that contain more than two operations. The student can rewrite a cube root so that the radicand has no cube factors.

Competency #2: Functions The student uses functions to interpret and analyze a variety of contexts. Functions describe situations where one quantity determines another.				
Success Criteria				
Performance Indicators	**Emerging**	**Progressing**	**Proficient**	**Exceeds**
a. Uses different representations to interpret and analyze functions, calculate and interpret average rate of change, evaluate inputs in the domain using function notation and choose if the situation is best represented by a linear or exponential model. *F-IF.1.2, 1.1, 2.5, 2.6* *S-ID.3.7, F-LE.1.1, 2.5*	The student defines a relation and a function, identifies dependent and independent variables, and recognizes different representations of a function.	The student identifies the domain and range, explains the features of linear and exponential functions..	The student uses different representations to interpret and analyze functions, calculate and interpret average rate of change, evaluate inputs in the domain using function notation and choose if the situation is best represented by a linear or exponential model.	The student creates a function rule to model a given situation that best models a problem and defends their choice.
b. Build a sequence or function that models a relationship between two quantities, build new functions from existing functions and interpret key features of graphs and tables given a verbal description. *F-IF.1.3, 2.4, F-BF.1.1b, 1.1c, 2.3*	The student describes the relationship between two quantities. Given a graph of the relationship between two quantities the student can identify key features.	The student models the relationship between two quantities with a function. Given a graph and/or table of the relationship between two quantities the student can identify key features.	The student builds a sequence or function that models a relationship between two quantities, builds and/or transforms new functions from existing functions, identifies the transformation, and interprets key features of functions using either a graph, table, or verbal description.	The student creates multiple functions to model a given situation.

c. Construct, graph and compare linear, quadratic and exponential models, solve problems and interpret expressions for functions, making conclusions about their meaning in terms of the situation they model. *F.IF.3.7a, b, c, e, F-IF.3.8a, b, F-IF.3.9, F-BF.1.1a F.LE.1.1, 1.2, 1.3*	The student identifies the different forms of linear, quadratic, and exponential equations. The student can graph piecewise-defined and absolute value functions.	The student distinguishes between situations that can be represented with linear, quadratic, and exponential functions and describes how a function changes when its parameters are changed.	The student constructs, graphs and compares linear, quadratic and exponential models, solves problems and interprets expressions for functions, making conclusions about their meaning in terms of the situation they model.	The student constructs linear, quadratic, and exponential functions given a graph or description of the situation and defends their conclusions about the parameters of the function.

Competency #3: Statistics
The student uses a variety of data analysis and statistics strategies to analyze, develop and evaluate inferences based on data.

Success Criteria

Performance Indicators	Emerging	Progressing	Proficient	Exceeds
a. Summarize, represent, and interpret data in a single variable or two variables and interpret linear models, including assessing the fit of a function by analyzing residuals. Distinguish between correlation and causation. *S-ID.1.1, 2.5, 2.6, 3.7, 3.8, 3.9*	The student identifies a box plot, histogram, or dot plot on a number line for a given data set in one variable. The student identifies the constant rate of change in a linear model.	The student represents data with an appropriate model. The student identifies slope and y-intercept of a linear model. Students can plot residual values.	The student summarizes, represents, and interprets data in a single variable or two variables and interprets linear models, including assessing the fit of a function by analyzing residuals. The student can distinguish between correlation and causation.	The student draws conclusions from a linear model, making contextual conclusions about trends in the data. The student relates the correlation coefficient to causation in a contextual model.

b. Use the center and spread to compare two or more different data sets and use their understanding of normal distribution and the empirical rule to answer questions about data sets.. *S-ID.1.2, 1.3*	The student can define measures of center and spread of data.	The student can calculate the measure of the center and spread of data and identify the appropriate measure of center and spread for a set of data.	The student uses the center and spread to compare two or more different data sets and use their understanding of normal distribution and the empirical rule to answer questions about data sets.	The student uses contextual data from two or more data sets and draws conclusions based on the distribution and spread.